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CONTENTS

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THE CARNEGIE FOUNDATION FOR THE ADVANCEMENT OF TEACHING[1]

THE ACTUARIAL SIDE OF THE RETIRING ALLOWANCE SYSTEM

THE foundation has now had four years of history. It seems, therefore, desirable to examine as critically as possible the experience gained in this interval. It will be remembered that in each report emphasis has been laid upon the fact that the income of the foundation could sustain permanently a satisfactory retiring allowance system for only a limited number of teachers and that it was desirable to determine at as early a date as practicable the approximate load the income could carry; or, put in another way, to determine the number of teachers as well as the number of institutions which the foundation might safely include in the retiring allowance system.

For the sake of continuity I venture to state in some detail the process through which the trustees have gone.

When the first $10,000,000, with its income of $500,000, was placed in the hands of the trustees, the problem before them presented a variety of factors, some of which were of an actuarial nature, but mainly the factors were of an educational and social character.

From the actuarial standpoint the problem could be stated in several ways. Perhaps the most simple way to state it is in the following terms. Assuming one thousand college professors at an average age of forty-seven, assuming three fourths of

[1] Extract from an advance copy of the Fourth Annual Report of the president and of the treasurer.

them to have wives, assuming an average pension of $1,000, and assuming that surviving widows would receive half of the pension which their husbands had earned, what would be the probable sum necessary to set aside in order to meet the annuities which would finally result if every professor retired at sixty-five?

To answer this question one must assume a mortality table and a rate of interest. Teachers have a better expectation of life than that indicated in the American mortality tables, and it was therefore necessary to use some table which represented more nearly the expectation of life in the case of preferred risks. The best authority available for this purpose is the McClintock tables, prepared by Mr. Emory McClintock, actuary of the Mutual Life Insurance Company of New York. These tables were made up by taking into consideration all the standard annuity tables in use in 1899, such as Finlayson's table (which was for many years the standard in Great Britain), the results of the French companies and also the experience of the New York Life and the Mutual Life Insurance companies in the writing of annuities. The lives of such annuitants form very much the same class of risks which those of teachers offer. This table was adopted as the New York standard for annuities after the recent insurance investigation, the law going into effect January 1, 1907. The difference in the life expectation, as computed by the American mortality tables and by the McClintock tables, is shown in the following comparisons.

Another assumption which must be made is the rate of interest. The rate prescribed by law, upon which life insurance companies base their calculations, is 3½ per cent.

Assuming this extreme case, the actuaries estimated that a capital of $10,000,000 would permanently carry such a load as that indicated for a body of approximately three thousand teachers. Some teachers will, however, die before reaching sixty-five; others will resign; but, most important of all, the bulk of teachers who reach the age of sixty-five will prefer to teach for some years longer, and the foundation receives five per cent. instead of three and a half. All of these considerations indicate that under such conditions as hold in practise such a capital would supply an average allowance of $1,500 a year to such retired teachers and their widows as are likely to be furnished by a body of three thousand professors. This estimate was given in the first annual report.

EXPECTATION OF LIFE

Age	American Mortality Tables	McClintock's Tables
30	35.33 years	35.12 years
35	31.78	31.61
40	28.18	28.08
45	24.54	24.56
50	20.91	21.11
55	17.40	17.97
60	14.10	14.65
65	11.10	11.76
70	8.48	9.18
75	6.27	6.96
80	4.39	5.13
85	2.77	3.67

On the other hand, there are numerous facts on the other side of the argument which will occur to every one. Such an assumption provides for less than one hundred institutions (or, with the sixteen millions now in control of the foundation, for perhaps one hundred and twenty institutions, of which about one half have now been admitted). It can not provide for all the colleges of America, and this fact has been emphasized in each annual report. In addition, we have taken no account of the growth of the institutions of learning.

If we assume that Harvard and Columbia are to have in the next generation faculties of two thousand instead of two hundred, if we assume that salaries are to be greatly increased, and if we assume that every professor is to claim his retiring allowance the moment it is available to him under the rules, it is clear that the large endowment of the foundation will be inadequate for even those institutions which have been admitted.

The truth is, however, that the matter is only in a partial sense an actuary's problem; all these assumptions do not detract from the fact that a well informed and conscientious body of trustees can, with the amount of income now in their control (some $800,000), maintain a satisfactory system of retiring allowances for perhaps five thousand teachers, distributed in about one hundred and twenty institutions. To do this is mainly a problem of common sense and fairness, not one of actuarial computation.

This is the practical advice which the trustees received from the actuaries themselves at the beginning of their administration. They said:

> The problem is only partly actuarial. No man can possibly predict what will happen under any assumed method of retirement. Frame your rules according to your judgment of what will best serve the interests of the teachers, within the general estimates indicated. Reserve carefully the power to amend your rules of retirement as circumstances may require, and go forward to acquire such experience as will enable you to make permanent and final rules.

This is the course which the trustees pursued; there was really no other open to them. They adopted certain rules for the granting of retiring allowances, always accompanying the statement of the rules with the following provision:

> The Carnegie Foundation for the Advancement of Teaching retains the power to alter these rules in such manner as experience may indicate as desirable for the benefit of the whole body of teachers.

This was accompanied by the additional statement that a pension once granted would not be affected by a subsequent change in the rules.

THE ADOPTION OF THE PRESENT RULES

It was after such conference with expert actuaries that the present rules were framed. At that time a smaller number of institutions seemed likely to be eligible than has since proved to be the case. The state institutions have within the last year been made eligible, and many colleges which at that time had denominational restrictions of a legal sort have since removed them and have become thereby eligible for consideration. The most the trustees hoped for at that time was to establish retiring allowances in enough institutions to bring in the retiring allowance plan as a part of American college administration. As stated in the first annual report, pages 30, 31:

> It is estimated that an income of $500,000 will maintain a system of retiring allowances, upon the scale adopted, for something over three thousand professors. This would correspond to the admission of somewhere between one hundred and one hundred and twenty institutions to the accepted list. . . . The establishment of an effective system of retiring allowances in one hundred institutions in the United States and Canada will contribute vastly more to the introduction of the retiring pay principle in American education than the maintenance of a charitable fund for a much larger number of institutions. Once the principle is established, and in so large a number of institutions as this, it will be necessary for institutions which for any reason are not eligible to this list to provide such retiring allowances for professors from other sources. This estimate, though only an approximate one, brings squarely before the trustees the consideration of the probable limit of the fund itself.

Much thought was given to the framing of such rules as might best serve the inter-

ests of teachers. The underlying principles which seemed to be clear were these:

1. The retiring allowance must come to the teacher as a right and in accordance with fixed rules.

2. It should form a fair proportion of his active pay and a larger proportion of small salaries than of large ones, a condition which was rendered fair by paying the same proportion of the first thousand dollars of active pay to all.

3. The retiring allowance should be available at some fixed age and after some stated period of service.

4. Some account should be taken of disability.

5. The retiring allowance system should embrace in its provisions the widows of teachers who under the rules had become eligible to retiring allowances.

The question of the minimum limit at which retirement on the ground of age should be permitted was one concerning which there was wide difference of opinion. The two ages most often suggested to the trustees were sixty-five and seventy. A number of teachers argued that seventy was early enough for a fixed date for retirement. More than one teacher of prominence urged that a teacher was at his best between sixty-five and seventy (these were all men past sixty-five). On the whole, however, it seemed clear that if the right to a retiring allowance did not mature till the age of seventy, a large part of the benefit of the endowment would be lost. The trustees therefore fixed upon sixty-five as a reasonable minimum limit upon which retirement on the ground of age could be claimed, leaving the question of the continuance of a teacher's service beyond that period to be determined entirely by the college and himself. The rule which resulted from this action is as follows:

Rule 1. *Retirement on the Basis of Age.*—Any person sixty-five years of age, who has had not less than fifteen years of service as a professor and who is at the time a professor in an accepted institution, shall be entitled to an annual retiring allowance, computed as follows:

(*a*) For an active pay of twelve hundred dollars or less, an allowance of one thousand dollars, provided no retiring allowance shall exceed ninety per cent. of the active pay.

(*b*) For an active pay greater than twelve hundred dollars the retiring allowance shall equal one thousand dollars, increased by fifty dollars for each one hundred dollars of active pay in excess of twelve hundred dollars.

(*c*) No retiring allowance shall exceed four thousand dollars.

Computed by the formula: $R = A/2 + 400$, where R = annual retiring allowance, and A = active pay.

It seemed extremely desirable that a retiring allowance system should include some provision for teachers who, after long service, have become broken in health or who by physical infirmity, such as the loss of hearing, are incapacitated for their calling. Among the most pathetic cases in the profession of the teacher and those most embarrassing to the colleges themselves have been the ones in which teachers have, after faithful service, broken in health and found themselves with approaching age practically helpless. In consequence the trustees adopted a second rule providing for retirement on the ground of service, intended to meet such cases as those referred to, together with the rare cases which now and then arise when a man of real genius as a scholar might prefer to accept a smaller pension and devote himself exclusively to productive work in science or literature. The trustees realized that retirement below the age of sixty-five threw upon the foundation a larger load than the retirement of one above that age. It was believed, however, that the number of teachers who would avail themselves of retirement under

such conditions would be confined almost exclusively to those who were physically impaired, and that the load coming from this provision would be small. The second rule, providing for retirement on the ground of service, is as follows:

RULE 2. *Retirement on the Basis of Service.*—Any person who has had a service of twenty-five years as a professor, and who is at the time a professor in an accepted institution, shall be entitled to a retiring allowance computed as follows:

(*a*) For an active pay of twelve hundred dollars or less, a retiring allowance of eight hundred dollars, provided that no retiring allowance shall exceed eighty per cent. of the active pay.

(*b*) For an active pay greater than twelve hundred dollars, the retiring allowance shall equal eight hundred dollars, increased by forty dollars for each one hundred dollars in excess of twelve hundred dollars.

(*c*) For each additional year of service above twenty-five, the retiring allowance shall be increased by one per cent. of the active pay.

(*d*) No retiring allowance shall exceed four thousand dollars.

Computed by the formula: $R = A/100(b + 15) + 320$, where R = retiring allowance, A = active pay, and b = number of years of service.

The second rule thus became a complex one, covering service and disability. In addition, the executive committee has, by the authority of the trustees, granted occasional temporary disability allowances, usually for one or two years' duration, to enable a teacher who has broken down to regain health.

A third rule provided for a pension for the widow of any teacher who, either on the ground of age or service, was entitled to a retiring allowance.

These rules have now been in operation four years. During this period an enormous amount of correspondence has gone on between the foundation and teachers and college officers in all parts of America. The rules have been criticized and examined from every point of view. It seems, therefore, an opportune moment to review the experience of the foundation in their administration and to reexamine the whole matter in the light of this experience. Before proceeding to this examination, however, some light will be thrown on the question by the testimony of the teachers who have accepted retiring allowances. I have written to each teacher who is receiving a retiring allowance and asked a frank statement of the reasons for his retirement. It is a part of the invariable policy of the Carnegie Foundation to place in the hands of those interested in education the fullest details respecting the foundation and its administration. In accordance with that policy the nature of these replies is indicated in the following summary.

THE REASONS WHY COLLEGE TEACHERS RETIRE

The inquiries just referred to were addressed to teachers on the retired list, with the understanding that individual letters were not to be quoted. The summary which follows represents, therefore, only such classification of the replies as is possible without direct quotation. The correspondence makes an interesting contribution to the history of this matter, and throws light on the varied conditions of college administration in small and large institutions and in various parts of the continent.

Letters were addressed to two hundred and eleven teachers on the retired list, asking for the purposes of the foundation a brief statement of the reasons for retirement. Replies were received in practically every case, and these were, with few exceptions, sufficiently definite to give a clear idea of the motives, or the combination of motives, which induced the writer to retire from active service.

For the sake of clearness and in order to help our discussion of the rules, it is best to consider these replies in two groups: first, the replies of those who retired after reaching the age of sixty-five under Rule 1; second, the replies of those who retired below the age of sixty-five under Rule 2.

Some one hundred and sixty-five letters were received from professors who had retired at sixty-five or over. These men can be divided as to age into two groups approximately equal in number, the one group retiring at ages between sixty-five and seventy, and the other retiring above seventy. The size of this second group is, however, probably disproportionately high because previous to the establishment of the foundation many teachers continued in service longer than they would under present conditions.

Of the whole number retiring on reaching sixty-five or later, twenty-seven, or nearly one sixth, state that their retirement was distasteful to them. They were, in their judgment, in full vigor of mind and body, but either on account of some statutory provision of their college, or by reason of the advice or wish of the college administration, they felt their retirement to be necessary.

In addition to the twenty-seven men who state frankly that they retired against their own wishes and judgment, there is a considerable group who indicate that they were induced to ask for a retiring allowance through a foreboding on the subject of age. They retired not on account of pressure from the administration or on account of a statutory provision, but because they wished to anticipate the formal suggestion of such action.

Various personal considerations were given for retirement of a sort which do not permit classification. For example, a few professors in small colleges felt the burden of too much elementary teaching and the hopelessness of relief in view of the poverty of their colleges. Under such circumstances, they preferred to retire altogether from teaching. A small group retired out of dissatisfaction with the attitude of their colleges toward their subject; one teacher thought that a wise husbandry of the college's resources demanded the abolition of his department. Recent revolutionary changes in science caused five men between sixty-five and seventy-five to conclude that younger men were more capable of adapting class-room methods to the new discoveries. Two frankly stated that their scholarship seemed to them to belong to an older generation, and it was too late to begin the mastery of new methods.

The largest group—fifty-two in all, nearly one third of those retiring on the ground of age—wrote in a serene and cheerful spirit. In the main the tenor of their letters was to the effect that they had discharged their duties to their profession, and with growing bodily infirmities they were glad to retire from active duties as teachers to some long-deferred study or research. These men wrote with grateful hearts concerning the opportunities for work which their profession had given them, and with equal gratitude for the provision which enabled them to look forward to a quiet and useful old age. If any man is discouraged over the outlook of the American scholar, he will get new faith by reading the letters of these veterans, some of whom had filled professors' chairs for sixty years.

From teachers who had retired under the provision of Rule 2 and who, on retirement, were below the age of sixty-five, forty-two letters were received. Of these only twelve had retired on the ground of

impaired health—four (ages fifty-nine, sixty-one, sixty-three, sixty-four) suffering from defective eyesight or hearing, and eight (ages fifty-four, fifty-six, fifty-eight, fifty-eight, sixty-one, sixty-two, sixty-four, sixty-four) having developed some malady or incurred a general breakdown in health. Of the remaining thirty, ten (ages two each at fifty-two, fifty-four, sixty-two, sixty-three and sixty-four) retired on account of some college complications, five of them stating explicitly that their resignations were requested by the presidents of their respective institutions or that they were dismissed.

Twenty still remain to be accounted for. These were in good health and in their own judgments capable of teaching satisfactorily. Five (ages fifty-five, sixty, sixty, sixty, sixty-three) desired to engage in the work of research or other professional labor, with the additional reason in one case of dissatisfaction with the attitude of the student body and in another the fear that the college might prefer retirement. Two (ages sixty and sixty-three) took advantage of the opportunity for family reasons; two (ages sixty-one and sixty-three) thought that younger colleagues ought to have the chance to occupy the positions they held; five (ages fifty-one, fifty-seven, fifty-eight, sixty, sixty-two) desired to engage in business; six (ages fifty-one, fifty-four, fifty-six, sixty, sixty-two and sixty-three) desired recreation and relief from the recitation and lecture room.

The statements by these two groups of men are most illuminating in respect to the actual working of such provisions as are incorporated in the present rules.

THE WORKING OF THE RULES FOR RETIREMENT AND THEIR BETTERMENT

The following table shows in condensed form the financial load which has resulted in accepted institutions under the operation of the rules as they have hitherto stood. The statement is confined to the accepted institutions for two reasons—first, the teachers in these institutions are the only teachers who have had free opportunity to avail themselves of the retiring allowance provisions; and secondly, these institutions contain the only body of teachers for whom the foundation has accepted permanent responsibility.

COST OF RETIREMENTS AT THE AGE OF SIXTY-FIVE OR OVER

Year	No. of Accepted Institutions	No. of Teachers in Faculties	No. of Retired Teachers on Roll	Average Age at Retirement	Annual Grant of Retiring Allowances	Number of Widows Pensioned	Annual Grant of Widows' Pensions	Total Annual Grant at End of Year	Deductions through Death	Annual Load at End of Year
1905–6[2]	52	2,261	34	71.4	$ 52,365	3	$2,700	$ 55,065		$ 55,065
1906–7	55	2,309	64	70.7	99,160	5	4,340	103,500	$13,710	89,790
1907–8	62	2,444	85	70.7	136,365	5	4,020	144,405	3,880	140,525
1908–9	67	2,966	129	70.6	214,250	11	7,995	222,245	1,940	220,305

COST OF RETIREMENTS AT AGES BELOW SIXTY-FIVE ON BASIS OF SERVICE

Year	No. of Teachers Retired below 65	Average Age at Retirement	Annual Grant of Retiring Allowances	No. of Widows Pensioned	Annual Grant of Widows' Pensions	Total Annual Grant at End of Year	Deductions through Deaths	Annual Load at End of Year
1905–6	5	62	$ 9,395	1	$ 600	$ 9,995		$ 9,995
1906–7	15	60.3	25,810	6	5,125	30,935	$2,190	28,745
1907–8	26	59	39,460	14	13,205	52,665	600	52,065
1908–9	40	58.6	62,355	21	20,390	82,745	4,745	78,000

[2] June to October, 1906.

ALLOWANCES FOR TEMPORARY DISABILITY

Year	Number	Amount
1905–6	8	$11,675
1906–7	10	14,215
1907–8	14	22,615
1908–9	17	28,235

The discussion of these statistics will be most profitable if the two groups are again considered separately.

(A) *Retirements on the Ground of Age (Rule 1)*

On the whole the results obtained under the use of this rule present a satisfactory outcome. Teachers who have passed the minimum age at which a retiring allowance may be claimed have apparently availed themselves of the opportunity to retire in much the manner in which the trustees had anticipated.

With regard to the objection voiced by a considerable group that they were retired while still capable and eager to discharge their duties, a word may be said. The question of compulsory retirement at a fixed age is one which has been much discussed. Several institutions have adopted such a rule, the age of retirement being fixed at ages ranging from sixty-five to seventy years.[4] In the case of any individual the active service may be lengthened by action of the college trustees. The question whether compulsory retirement is a wise provision in an institution of learning is one upon which something may be said on both sides.

It is clear that the artificial closing of the work of a great teacher is a matter to be regretted, and in the active professions of the world sixty-five, or even sixty-eight, is a period in which many men do their best work. In trade, in politics and in the profession of the law the years between sixty-five and seventy are those in which men assume successfully the heaviest responsibilities. Viscount Morley at seventy-one is framing a new plan of government for an empire of three hundred million people. Chief Justice Marshall guided the deliberations of the Supreme Court of the United States with unabated vigor until his death at eighty. Lord Palmerston first became Prime Minister of England in his sixty-ninth year. Von Moltke was seventy at the beginning of the Franco-Prussian War. It would have been a great loss to scholarship to have retired at sixty-five Bunsen, who taught at Heidelberg until he was seventy-eight; or Von Ranke, who taught at Berlin until he was seventy-six; or Von Ranke's colleague, Mommsen, who was still teaching when he died at the age of eighty-six. The University of Glasgow would have suffered if it had not permitted Lord Kelvin to occupy his professorship until his voluntary retirement at seventy-five, and the University of Jena is a stronger institution because Ernst Haeckel is still professor of zoology there, in his seventy-sixth year. Lord Acton was sixty-one before he began his eleven years' fruitful service in the chair of modern history at Cambridge, and Edward A. Freeman was the same age when he accepted the corresponding chair at Oxford. Upon Freeman's death in his seventieth year he was succeeded by James Anthony Froude, then seventy-four. It

[4] The following institutions have adopted more or less definite regulations for the retirement of professors upon reaching a given age. In most instances provision is made for the extension of the age limit by the trustees: University of Cincinnati, 65 years; Cornell University, 65; Dartmouth College, 70; Harvard University, 60 voluntary, 66 compulsory; Grinnell College, 70; Leland Stanford Junior University, 65; Marietta College, 65; Oberlin College, 65 voluntary, 68 compulsory; New York University, 65; University of Minnesota, 68; University of Pittsburgh, 65 (tacit understanding, but no rule); Swarthmore College, 65; Vassar College, 65 voluntary, 70 compulsory; Williams College, 65 voluntary, 68 compulsory; Yale University, 65 voluntary.

is also evident that the fixing of an arbitrary limit causes some apprehension to men approaching that period.

All this, however, does not affect the fact that notwithstanding the presence of notable service by men of seventy and upward, the average man of ability does not attain to such achievement, and that the average men are inclined to cling to their regular duties and to their official positions after their efficiency is seriously impaired. It is not easy for the individual to differentiate between those motives which are egoistic and those which are not. Few men at seventy are critical judges of their own efficiency. While, therefore, a fixed and invariable rule for the retirement of a teacher may not be the best solution, it is clear that the college professor at such an age ought to be willing to leave the question of retirement, in some measure at least, to the judgment of others. As our American institutions are organized, it is not easy to keep men in position who render partial service.

There is another view of retirement voiced by some of these teachers which seems worth notice, and that is the fear of lack of some agreeable and useful way of spending one's time if regular teaching duties are given up. We are accustomed to this attitude in the case of the business man, but one scarcely expects to find a scholar at a loss to know how to entertain himself in old age. The situation suggests, at least, that college professors do not always have sufficiently broad foundations for their scholarship nor adequate connection with varied and enduring human interests.

Only one serious criticism has been made of this rule. It is urged that the rule does injustice to the profession of the teacher by excluding service in the grade of instructor from counting toward the earning of a retiring allowance. It is urged that the position of instructor[5] is one calling for high professional training; that it belongs to the recognized professional grades of university work; that the work of an instructor in one of the large universities is often of a higher order and involves greater responsibility than that of an assistant professor in a small college; and finally that the actual work of teaching in the large institutions has for the last two decades fallen in increasing measure upon the shoulders of the instructor. These criticisms are valid ones. There is a further effect noticeable under the present rules the tendency of which is bad, namely, the pressure upon colleges to appoint men to faculty places in order that the term of service may begin to count toward a pension. This pressure is natural; it is difficult to withstand; and it is almost wholly bad. Advancement in salary and eligibility to a pension ought not to depend on promotion to an assistant professorship. I therefore recommend the amendment of this rule so as to include recognition of the service of the teacher in the grade of instructor.

The practical question which arises is: "How much ought the term of service to be lengthened in order to include service as an instructor?"

This question is not easy to answer, since the statistics of ten and twenty years ago do not fit the experience of to-day. Men were appointed twenty years ago to instructorships at an earlier age than to-day. In fact, the place of instructor is to-day a different one. Furthermore, in the smaller colleges service in this grade lasts usually only a short time, while in the large universities it may last five or ten years, and

[5] The position of lecturer in Canadian universities corresponds to that of the instructor in the United States.

in some cases, and those of worthy and useful teachers, it lasts indefinitely. The experience of a group of the smaller strong colleges[6] indicates that instructors are appointed between the ages of twenty-three and twenty-six, on the average at twenty-four and seven tenths. On the other hand, the experience of a group of the stronger universities[7] indicates that instructors in these institutions begin their service between the ages of twenty-five and thirty, or on the average at twenty-eight. Each group is geographically well distributed. On the whole, it would be fair to assume that a man who is appointed an instructor at twenty-five will either be an assistant professor at thirty-five or earlier, or will remain permanently an instructor. If the rule for retirement on the basis of age is therefore amended so as to read: "Any person sixty-five years of age who has had not less than fifteen years' service as a professor or not less than twenty-five years' service as an instructor, and who is at the time either a professor or an instructor in an accepted institution," etc., the service of a teacher in the grade of instructor will be fully recognized. I recommend this change.

(B) *Retirements under Rule 2*

The outcome of an unrestricted opportunity to retire after twenty-five years of service as a professor is evident on the financial side in the fact that under this provision annual pensions to the amount of $78,000 have resulted in three years, an amount greater than twenty-five per cent. of the whole cost of the retiring allowances of those retired under Rule 1. This is a result far beyond the anticipations.

[6] Haverford, Grinnell, University of the South, Bowdoin, Cornell (Iowa), Beloit, Allegheny, Lawrence, Lake Forest, Rose Polytechnic, Hobart, Knox.

[7] Columbia, Harvard, Wisconsin, Leland Stanford Junior, Toronto, Northwestern, Iowa, Indiana.

The expectation that this rule would be taken advantage of almost wholly on the ground of disabilities has proved to be ill founded. Of the forty teachers retired on this basis only twelve retired for physical reasons. The average age of those thus retiring was sixty and three tenths, while twenty-eight retired on other grounds at an average age of fifty-nine years. In the first group were only five below sixty, the minimum age being fifty-four; in the second there were eleven below sixty; three retiring at the age of fifty-four, two at the age of fifty-two and two at the age of fifty-one.

These retirements indicate that when a teacher has reached the age when he may claim the minimum pension, he may be put under pressure to retire whether he desires retirement or not. It has been urged that one of the benefits of the foundation consists in the opportunity thus afforded the colleges to get rid of teachers who have worn out their usefulness or who have lost interest. Whatever there may be in this claim, it is evident that it is more than counterbalanced by the opportunity which is thus opened to bring pressure to bear on the teacher, or by the tendency of the teacher assured of a retiring allowance to become ultra-critical toward the administration. The situation is not a good one either from the standpoint of academic freedom or of academic contentment. Furthermore, it is no part of the function of a retiring allowance system to care for the disagreements of college life. These are problems of administration.

The idea that the foundation could indirectly give aid to research by the retirement below the age of sixty-five of some man devoted to research rather than teaching is also one which, on the whole, seems elusive. The correspondence outside of these letters indicates that a number of

teachers have persuaded themselves that they are specially intended for research. Some of these have a small income which, even with the minimum pension, promises a safe, if not ample, support. Others are "tired of teaching." It seems that this rule offers too large a temptation to certain qualities of universal human nature. Furthermore, the object of the Carnegie Foundation is not the encouragement of research (desirable as that may be), nor is it concerned with the transfer of men from the calling of the teacher to some other. Its object is the advancement of teaching. Experience seems to prove that the attainment of that object lies in providing security and protection to those who remain in that calling. It seems to me that Rule 2 in its present form is a mistake. As I am in the main responsible for this, I have sought in the light of experience and through consultations with numbers of teachers to ascertain what changes can at this time fairly and wisely be made. I have also sought to obtain the opinion of actuaries and others as to the general results of service pensions. The literature of this subject is meager, but the testimony from all sources seems to indicate that, while a disability pension is a helpful feature of retirement plans, a service pension ought to rest on the basis not of a minimum but of a maximum service. It is clear also from correspondence and consultations with teachers that the features of the present service pension which are most highly valued are the protection to the teacher after twenty-five years of service in case of disability, and the protection of his widow in the case of death. These two features should, in my judgment, be preserved. I recommend, therefore, that Rule 2 be amended in such manner that retirement at the end of twenty-five years of service, and before the age of sixty-five, be available to a teacher only in case of disability so serious as to unfit him, as shown by a medical examination, for the work of a teacher. Such a change will command the approval of the great body of devoted and able teachers and is in accordance with the spirit of the rules as originally framed.[8]

One other feature of the administration of these rules has proven difficult and in some respects unsatisfactory. This is the retiring of professors in the schools of medicine and law.

It is important that the medical school and the law school become more closely parts of the general system of education and more truly related to universities and university ideals. This result is coming, and an increasing number of teachers in schools of both medicine and law are giving their entire time to teaching and to investigation. At the present time, however, the bulk of teachers of law and of medicine are practitioners. The presence of such men in the schools is desirable, but the retiring allowance system was never intended for them. As matters now stand, however, it is difficult to determine where the line should be drawn in the cases of such professors. The rule provides at present that "teachers in professional departments of universities, whose principal work is outside the profession of teaching, are not included." This does not seem definite enough. The question as to whether the practise or the teaching is the principal work of a teacher of law or of medicine remains to a considerable extent a question of individual estimate. It seems desirable

[8] The changes here recommended by the president of the foundation were adopted by the trustees at their annual meeting on November 17, 1909, and the rules as so amended and as they are now effective will be found in an appendix to this report.

to amend this rule in such manner as to make the intent more definite.

In the use of the privileges of the foundation under such rules it ought not to be forgot by presidents, trustees and teachers that this noble gift for education was intended to serve primarily the faithful and efficient teacher, not to solve the difficulties of administration. The president of an accepted institution should keep in mind the purposes of the foundation as well as the wants of his college and the requests of individuals. To throw upon the foundation a load it was not intended to carry is to limit later the service it was originally designed to fulfil.

THE EIGHTH INTERNATIONAL CONGRESS OF APPLIED CHEMISTRY

On the evening of February 3, 1910, an informal gathering took place at which there were present among others, most of those to whom had been delegated the task of providing for the creation of an organization for the eighth International Congress of Applied Chemistry, by the London Congress last June; a representative of the Association of Manufacturing Chemists, the American Chemical Society, the American Electrochemical Society, the Society of Chemical Industry were each also present at this informal meeting.

The consensus of opinion was that the greatest success could be expected only if the most effective system and mode of organization could be had, and if each and every chemist in the United States could be made to feel that he himself directly or indirectly through his professional, business or educational affiliations, had a personal share of responsibility in the conduct and management of the congress from its very start and to its very end. This was regarded as the proper and correct guide in proposing any plans or schemes of organization.

The eighth congress is to convene in 1912 with Professor Edward W. Morley as honorary president and Dr. W. H. Nichols as acting president at a time and place to be determined by the organization of this congress. The most important part of the congress, in fact that by which its value and real success will be measured, is the amount of original matter, both scientific and technical, which it will be able to present to its members. To this end, every chemist in America who has or may have any original matter to present to this congress should begin without delay to prepare such matter, and have it in shape so that it may be presented to the congress in ample time for proper printing, classification and distribution to members and the technical and scientific press.

The congress, being held in the United States, will, with a great deal of right, naturally look to a very good showing from the chemists of the United States, and every chemist in this country, which is to be host to our foreign colleagues, should constitute himself a committee of one to get from himself, or from his friends, as much scientifically or technically valuable material as possible so that the proceedings and publications of the eighth congress may correctly reflect the true mental attitude of the chemists of the United States towards their profession, both as a pure science and as a part of the industrial activities of this country.

It is the hope that the program committee will be able to begin its activities effectively before the close of 1910, but in the meantime it behooves every chemist in the United States actively and energetically to consider how and in what way he can best contribute to the success of this congress, and particularly in the direction of papers and communications to the congress embodying the advance in this field since June, 1909, the date of the last congress.

At a meeting to be held in April or May, 1910, by those charged with the duty of providing suitable organization for the eighth congress some definite action as to such organization may be looked for. Those who have that responsibility are making every effort to get as many suggestions as to divisions of organization, mode of organizing and membership of the organization as possible. Every

one interested in having this organization on as broad foundation as possible is earnestly invited to present any suggestions that may be helpful in that direction, in writing by the middle of April, 1910, so that all these suggestions may be properly classified and collated and put in condition for most thorough consideration before the meeting above referred to actually takes place. Such communications may be addressed to the temporary secretary, Dr. B. C. Hesse, 90 William Street, New York City.

THE GRAZ INTERNATIONAL ZOOLOGICAL CONGRESS

THE committee having the affairs of the congress in hand have secured reduced rates on all of the railroads of Austria for the members and participants in the congress. First-class travel will be given on payment of second-class fares, and second-class for third-class fares. This applies not only to the excursions but to all railway travel in Austria from the moment the boundary is crossed, and is available from the tenth of August until the tenth of September. To avail themselves of this privilige members must have their membership cards before reaching Austria, and therefore they should send the fees for membership to the Steiermärkische Eskomptebank, Graz, Austria, so that the membership cards may reach them in good season. The money may be sent by postal order. Those who have not yet received the preliminary circulars of the congress, with the blanks for membership and excursions, should address the Praesidium des VIII Internationaler Zoologenkongress, Universitätsplatz 2, Graz, Austria. A second circular relating to the congress will probably be issued in March or early April. This will be sent to all whose names have been sent in, either as probable members or as desiring further information. It may be well to say that all persons intending to attend the congress should engage their return passage to America at the same time that they obtain their outward accommodations. European travel promises to be very heavy this year, and early application is advisable.

SCIENTIFIC NOTES AND NEWS

LORD RAYLEIGH has been elected a foreign associate of the Paris Academy of Sciences in succession to the late Simon Newcomb. Sir Patrick Manson has been elected a foreign correspondent in the section of medicine and surgery.

THE Edison medal of the American Institute of Electrical Engineers was presented to Professor Elihu Thomson at the annual dinner of the institute on February 24.

FOR the meeting of the British Association for the Advancement of Science, which is to take place this year at Sheffield, beginning on August 31, under the presidency of the Rev. Professor T. G. Bonney, F.R.S., the following presidents have been appointed to the various sections: Section A (Mathematical and Physical Science), E. W. Hobson, F.R.S.; Section B (Chemistry), J. E. Stead, F.R.S.; Section C (Geology), Professor A. P. Coleman, Ph.D.; Section D (Zoology), Professor G. C. Bourne, D.Sc.; Section E (Geography), Professor A. J. Herbertson, Ph.D.; Section F (Economic Science and Statistics), Sir H. Llewellyn Smith, K.C.B.; Section G (Engineering), Professor W. E. Dalby, D.Sc.; Section H (Anthropology), W. Crooke, B.A; Section I (Physiology), Professor A. B. Macallum, F.R.S.; Section K (Botany), Professor J. W. H. Trail, F.R.S.; Section L (Educational Science), Principal H. A. Miers, F.R.S.

THE Athenæum Club has elected under the provisions of the rule which empowers the annual election of nine persons "of distinguished eminence in science, literature, the arts, or for public services," Mr. William Bateson, F.R.S., director of the John Innes Horticultural Institute, Merton, and Professor Henry Taylor Bovey, F.R.S., dean of the faculty of applied science of McGill University.

DR. A. R. FORSYTH has resigned the Sadlerian professorship of pure mathematics at the University of Cambridge.

SIR WILLIAM HUGGINS, F.R.S., the eminent astronomer, celebrated his eighty-sixth birthday on February 7 at his residence at Tulsehill.

Dr. Lawrence F. Flick, who has resigned from the Phipps Institute, Philadelphia, was the guest of honor at a dinner at the University Club on February 2. Dr. Flick was presented with a massive silver loving-cup, bearing the engraved autographs of the members of the staff.

M. Emmanuel de Margerie has been elected president of the Paris Geographical Society.

Sir Ernest Shackleton has been presented with the Constantine gold medal of the Russian Geographical Society.

Mr. Bion J. Arnold has been appointed chief engineer of subways of Chicago, and will organize the work of constructing a system of subways for that city.

Dr. Rhodain will be the head of the Belgian sleeping sickness mission to the Congo. The mission proposes to make its center of work the Kalengwe Falls, in the neighborhood of which the disease is very prevalent.

Mr. John Claude Fortescue Fryer, B.A., Gonville and Caius, has been appointed to the Balfour studentship at Cambridge University. A grant of £200 from the Balfour Fund has been made to Mr. Clive Forster Cooper, M.A., Trinity, for an investigation into the Tertiary vertebrate fauna of India, and a grant of £40 to Mr. Kenneth Robert Lewin, B.A., Trinity, in furtherance of his work in protozoology.

Professor William T. Sedgwick, of the Massachusetts Institute of Technology, and Mrs. Sedgwick expect to leave this country in March for a European trip.

Mr. Roosevelt will deliver the Romanes lecture at Oxford University on May 18.

Dr. Bernard Bosanquet, formerly professor of moral philosophy in St. Andrews University, has been asked by the Senatus of Edinburgh University to become the Gifford lecturer for the usual period of three years, from October, 1911.

Dean F. E. Turneaure, of the College of Mechanics and Engineering of the University of Wisconsin, gave two addresses before the instructional staff of the College of Engineering of the University of Illinois on February 10 and 11. His subject on the first day was "The Stress in Bridges under the Load of Moving Trains," and on the second day, "Some Features of the Manhattan Suspension Bridge."

M. Etienne Boutroux will sail for the United States on the steamship *Adriatic* on February 23, to deliver a course of lectures at Harvard University. He will also make four public addresses at Cambridge under the auspices of the Cercle Français on the "Essence of Religion" and the "Movement of Contemporary Philosophy."

A tablet has been erected in memory of Robert Henry Thurston in the rooms of the American Society of Mechanical Engineers in the Engineering Societies building, New York City. Dr. Thurston was the first president of the society.

Mr. and Mrs. F. W. West, of Seattle, have endowed at Stanford University a lectureship to be known as the "Raymond F. West Lectureship on Immortality, Human Conduct and Human Destiny." It is arranged that at intervals of two years three lectures shall be given, by men standing in the front rank of eminence in this and other countries. The first course will be given in the year 1911. This course is in memorial of a son of Mr. and Mrs. West, a former student of Stanford University.

Through a committee formed to perpetuate the memory of the late Mr. Benn Wolfe Levy a studentship in biochemistry in the University of Cambridge has been endowed with £3,000.

Dr. Henry Wilde has offered the University of Oxford the sum of £600 for the foundation of an annual lecture on astronomy and terrestrial magnetism, in honor and memory of Edmund Halley, some time Savilian professor of geometry.

Dr. Charles Paine Thayer, professor emeritus at the Tufts Medical School, died on February 13, at the age of fifty-seven years.

Dr. Henry Byron Newson, professor of mathematics in the University of Kansas, known for his work on the theory of groups,

died suddenly on February 18, at the age of fifty years.

SIR CHARLES TODD, F.R.S., well known for his astronomical and meteorological work in South Australia, has died at the age of eighty-three years.

PROFESSOR W. HILLHOUSE, until recently professor of botany in the University of Birmingham, has died at the age of sixty years.

PROFESSOR F. PURSER, professor of natural philosophy in the University of Dublin, and the author of works on mathematics, died on January 28, at the age of seventy years.

DR. J. VOLHARD, professor of chemistry at Halle, author of the "Life of Liebig," published last year, has died at the age of seventy-five years.

THERE will be a civil service examination on March 3 to fill two vacancies in the position of ethnologist (male), Bureau of American Ethnology, Smithsonian Institution, at an initial salary of $1,500.

THE beautiful new lecture hall of the Academy of Natural Sciences of Philadelphia was opened with a short address by Dr. Edward J. Nolan to the Delaware Valley Naturalists' Union on the afternoon of January 29, preceding a lecture by Witmer Stone, one of the curators, on "The Conservation of Bird Life in the United States." The new lecture room has a capacity of 500 and is a great improvement, acoustically and otherwise, on the one heretofore used. The latter will be fitted up as one of the museum halls in remodeling the building in connection with the completion of the new wing, in which the library has been successfully installed. In the old hall vacated by the library the geological and paleontological collections will ultimately be arranged.

ARRANGEMENTS have been perfected between Captain Roald Amundsen and the Department of Terrestrial Magnetism of the Carnegie Institution of Washington regarding cooperation in magnetic work on the proposed Amundsen polar expedition to leave Norway this summer on Nansen's vessel, the *Fram*. After some general explorations in the South Atlantic and in the South Pacific Oceans, the *Fram* is expected to arrive at San Francisco in the summer of 1911. After outfitting there, she will head for Behring Sea and after entering the polar basin will then drift with the ice. It is expected that it will be about four years before she emerges again from the ice. While Captain Amundsen hopes that his vessel will drift across the North Pole or close thereto, his prime object is that of general geographic exploration. Dr. Harry M. W. Edmonds has been selected by him to fill the difficult post of surgeon and scientific observer. Dr. Edmonds had previously received training in magnetic observations while Dr. Bauer was in charge of the magnetic work of the Coast and Geodetic Survey; he furthermore has had experience in polar regions and was in charge of the Sitka Magnetic Observatory from the date of its establishment. He reported at Dr. Bauer's office in Washington early in February for the purpose of making the necessary preliminary arrangements and perfecting the instrumental outfit to be used. He expects to leave for Norway next June. Similar instruments will also be used on Captain Scott's Antarctic expedition. As the result of an effective cooperative arrangement with the recently returned Canadian Arctic expedition on the *Arctic*, commanded by Captain Bernier, the Department of Terrestrial Magnetism has just been furnished by Professor R. F. Stupart, director of the Canadian Meteorological Office, with the observations made by the special observer on board the *Arctic*, Mr. Jackson, of the Meteorological Office.

PROFESSOR J. C. BEATTIE, director of the department of physics of the South African College, Cape Town, and Professor J. T. Morrison, in charge of department of physics at Victoria College, Victoria, South Africa, have returned to their collegiate duties. Since November, 1908, they have been associated with the Carnegie Institution of Washington through the department of terrestrial magnetism, and have now completed successfully magnetic surveys in the regions of southwestern and eastern portions of Africa where magnetic data were most urgently needed. Previous to their association with the Carnegie In-

stitution, they had made magnetic surveys in South Africa with the aid of various grants and had thus gained the requisite experience for the larger task entrusted them by the institution.

At the recent holiday meeting of the Oklahoma State Teachers' Association, those engaged in the teaching of the sciences organized the Oklahoma Academy of Science. Forty-four members were at the initial meeting, but the lists for charter membership will be kept open till March 1. It is expected that the charter membership will not be less than 100. The following officers were elected: *President,* H. H. Lane, Norman; *First Vice-president,* C. E. Sanborn, Stillwater; *Second Vice-president,* D. D. Dunkin, Wilburton; *Secretary,* F. B. Isely, Tonkana; *Assistant Secretary,* D. W. Ohern, Norman; *Treasurer,* H. I. Jones, Muscogee; *Curator,* G. W. Stevens, Alva. At the first meeting several papers were read touching the various lines of investigation in which the workers are engaged. Meetings will be held annually at the Thanksgiving recess.

North Dakota has an Academy of Science organized in 1909. Originally the academy was organized on the basis of the natural sciences, but opinion now prevails that the political and social sciences should be included. The purpose of the academy is to promote cooperation among the workers in the different sciences, to secure more representative support and to improve the several forms of scientific work throughout the state. North Dakota is an enormous empire with a host of unsolved problems waiting for trained workers, especially in the fields of geology, biology and chemistry. The conservation of resources will find a very large place in the work of this academy, notably in the development and utilization of the almost immeasurable supply of lignite coal, valuable pottery and fire clays, and the great undeveloped work of forestation. The rapid growth of towns and the increasing needs for taxation will afford the sciences of sociology and political economy large fields of service. One of the important lines of biological activity which is being pushed by the members of the North Dakota Academy of Science is that of hydrobiology. A helpful ally in this work will be the new biological station which has been established at Devils Lake and is under the direction of the state university. The officers of the academy for the current year are: *President,* M. A. Brannon, of the State University; *Vice-president,* C. B. Waldron, of the State Agricultural College; *Secretary-treasurer,* L. B. McMullen, State Normal School, Valley City.

The third annual meeting and dinner of the Clark University Alumni Association was held in Worcester on Tuesday evening, February 1, the event being a part of the day's festivities in connection with the inauguration of Dr. Edmund C. Sanford as president of Clark College. The meeting was made notable by the celebration of President Stanley Hall's birthday, he being presented with a memorial from his former students in the form of individual letters and a loving cup. The dinner was attended by about 100. It was presided over by Dr. Hermon C. Bumpus, who introduced the following speakers: Dr. Sanford; Dr. Ferry, dean of Williams College; Dr. Thurber, of Ginn & Co.; President Lancaster, of Olivet College. At the business meeting, Dr. W. M. Wheeler, of Harvard University, was elected president and Dr. J. S. French, principal of the Morris Heights School, Providence, R. I., secretary.

The *Journal* of the American Medical Association states that the American Association for the Study and Prevention of Infant Mortality, which was organized recently in New Haven, has established permanent headquarters at the new building of the Medical and Chirurgical Faculty of Maryland, and will institute an active campaign. The section on federal, state and municipal prevention of infant mortality will be under the chairmanship of Dr. William H. Welch, Baltimore; Dr. L. Emmett Holt, New York City, will be chairman of the medical section, and Dr. Helen C. Putnam, Providence, of the section on education. Dr. Hastings H. Hart, New York City, director of the department of child-helping of the Sage Foundation, is chairman of the section on philanthropic prevention and Miss

Gertrude B. Knipp is executive secretary of the association.

THE question of the authenticity of the Kensington rune, which recently has aroused discussion among antiquarians seems to have entered upon a new phase by the announcement that the Minnesota Historical Society has, after a lengthy investigation, given its verdict in favor of the genuineness of the stone, which is dated 1362. The announcement is concurred in by the Scandinavian department of the University of Minnesota and by scientific men at the university who have carried on independently an examination of the stone with reference to language, historical conditions and the evidence of weathering of the stone and the runic lines. The Chicago Historical Society recently had the stone on exhibition, a lecture being delivered in favor of the genuineness of the stone by its owner, Mr. H. R. Holand, which was afterwards discussed by Professor George T. Flom, professor of Scandinavian languages and literature in the University of Illinois, who had been invited by the society to present the results of a philological examination of the inscription of the stone. Professor Flom maintained that the linguistic forms of the inscription are in this case the only scientific test and these are in themselves absolute and conclusive, and he showed by an analysis of the word forms, inflexions, phonology and meanings of certain words, and a presentation of the characteristics of the old Swedish language of the time, that the so-called rune-stone must be adjudged a fake. Its language is a mixture of nineteenth century Norwegian and Swedish, with a few antiquated words modified further by an evident antiquarian effort in orthography, which, however, the modern rune-master, not possessing a knowledge of old Swedish, fails to harmonize with the orthography and the pronunciation of the time. Professor Starr W. Cutting and Dr. C. N. Gould, of Chicago University, subscribe unreservedly to Professor Flom's views of the language of the stone. An interesting phase of the situation is presented by the fact of the verdict of the Minnesota Historical Society, which has recently bought the stone from the owner for $1,000 and given Mr. Holand a stipend of $2,000 for study in Scandinavian.

FOR some time there has been in contemplation the establishment of an imperial chemical institute at Berlin similar to the *Reichsanstalt*. The *Journal* of the American Medical Association states that the wholesale chemical industry has established an imperial society which decided at its last meeting to appropriate $225,000 for the founding of an imperial chemical institute. As a preliminary the association formulated the demand that the federal government should furnish the ground and that the Prussian department of education should supply a professor from the University of Berlin as president of the institute, and an associate professor as director of one department.

UNIVERSITY AND EDUCATIONAL NEWS

A GIFT of $150,000 for the erection of an administration building and library at the Rensselaer Polytechnic Institute of Troy, N. Y., by the Pittsburgh Alumni Association has been announced.

PROFESSOR W. J. HUSSEY, director of the observatory of the University of Michigan, announces that the university is about to receive gifts aggregating $20,000 from Mr. R. P. Lamont, of Chicago, a member of the class of '91. One gift, representing $17,000, is a deed of land directly east of the observatory, bordering upon the arboretum. This should always insure a sky line free from smoke and dust. Mr. Lamont has also furnished funds to start the construction of a 24-inch refracting telescope.

GOVERNOR W. R. STUBBS has given the University of Kansas $1,000 for a fellowship to investigate the extraction of medicinal substances from the glands of deep-sea mammals. The fellowship has been awarded to Roy Wiedlein, who will spend part of the time in Alaska.

AT the ninth annual dinner of the alumni of Stevens Institute, which took place at the Hotel Astor, New York, on February 12, nearly three hundred men cheered President Humphreys when he presented his program for the development of the institute. The other speakers included Dr. H. S. Pritchett,

president of the Carnegie Foundation for the Advancement of Teaching; Col. E. A. Stevens, of Castle Point; Hosea Webster, '82, of the Babcock & Wilcox Boiler Co.; H. M. Brinckerhoff, '90, president of the Alumni Association and electrical associate of Wm. Barclay Parsons; and E. H. Peabody, '90, of the Babcock & Wilcox Co., the toastmaster. President Humphreys announced that he had recently received $63,500 of the $1,250,000 which he expects to raise for the improvement and extension of the institute. This money is to be used for the purchase of the Castle Point estate, for the erection of several buildings, including a dormitory, a mechanical laboratory and an electrical laboratory, and to provide an adequate endowment fund.

The Minnseota *Alumni Weekly* states that President A. Ross Hill, of the University of Missouri, has notified the authorities of the University of Minnesota that he could not consider an offer of the presidency of the university.

R. D. Thomson, a graduate of Harvard University in the class of 1907, has been appointed instructor in electrical engineering in the University of Vermont.

Dr. H. Irving Eleshinger, associate in chemistry at the University of Chicago, has been appointed professor in the University of Pekin. Professor Oscar Eckstein, formerly instructor in chemistry in the University of Chicago, is director of the department of science.

Mr. A. J. Hebertson, reader in geography at Oxford University, has been appointed to a professorship of geography.

Mr. A. C. Seward, professor of botany at Cambridge University and a former fellow of St. John's College, has been elected to the professorial fellowship vacated by Mr. Bateson's resignation of the professorship of biology. Mr. Bateson has been made honorary fellow of the college.

At Oxford University Dr. Walter Ramsden, fellow of Pembroke; Dr. H. M. Vernon, fellow of Magdalen, and Mr. S. G. Scott, B.M., Magdalen, have been appointed demonstrators in physiology.

DISCUSSION AND CORRESPONDENCE

ON THE SO-CALLED NORWOOD "METEORITE"

The issue of Science for January 28 contains an article by Professor Frank W. Very entitled "Fall of a Meteorite in Norwood, Massachusetts," descriptive of what he supposes to have been a meteoritic stone said to have fallen on the farm of Mr. W. P. Nickerson, of Norwood, Mass., during the night between October 7–8, 1909. On account of the specific character of the description and for fear that this may be successful in giving the "Norwood meteorite" a place in the literature, I feel that another opinion with regard to the character of the specimen should be placed on record.

I saw the newspaper account of this fall directly after its occurrence, and after correspondence with Mr. Nickerson took the first opportunity that presented itself to examine the specimen, which was then on exhibition in a "dime museum" in Boston. Mr. Nickerson himself met me there and showed me the stone. Professor Very's account of the appearance of the mass is sufficiently accurate, but his interpretation of it is entirely erroneous. As a matter of fact, the specimen is a characteristic glacial bowlder of a basic igneous dike rock, the matrix in which has been weathered so as to leave the characteristic large phenocrysts of plagioclase projecting from the surface. There is no surface indication whatever of flowage or of the skin which is characteristic of freshly fallen stony meteorites. I broke off a piece of the stone and examined the fresh fracture with the greatest care under a hand lens without finding any indication of the existence of metallic iron in the mass. Since reading Professor Very's article, I have had a thin section of my fragment made. Microscopic examination of this proves the rock to be ordinary labradorite-porphyry—a diagnosis which has been confirmed by Dr. H. S. Washington, who has called my attention to his description of this rock type from Essex County, Mass.[1]

Mr. Nickerson told me about the broken bars of the gateway under which the mass was

[1] *Journal of Geology*, Vol. 7, p. 290, 1899.

found and the other circumstances as related by Professor Very, but he added a statement with regard to a bright flash of light which he had noticed in the sky during the evening of October 7. His description, however, was only that of an unusually brilliant shooting star. A meteorite of the size of this specimen would surely have illuminated the region over many square miles with almost the light of day, judging from the reports of known meteorites which have been seen to fall, but no such occurrence was reported from Norwood. If the falling of a meteorite was the cause of the broken bars, the mass has not yet been found, or at any rate it was other than the specimen described by Professor Very and seen by me.

The circumstantial nature of the observations made by the several persons who had to do with digging up the "meteorite," as quoted in the article to which reference is made, are not as conclusive to me as they are to Professor Very, through scepticism engendered by the falsity of nearly all of the many reports that have come to my office during the past sixteen years in which people have described "meteorites" that they "had actually seen fall" at their feet or on the lawn in front of their houses, or in the road, or in some other very near-by place. On request, samples of some of these "meteorites" have been sent in, one of them proving to be a piece of fossiliferous limestone, another a bit of furnace slag, another a glacial bowlder of trap rock, another a glazed stone that had been used in the wall of a limekiln, another a glacial bowlder of quartzite covered with a film of limonite. The list might be extended almost indefinitely, but it is not worth while. In almost every case mentioned, the mass when found "was so hot that one could not bear his hand on it."

EDMUND OTIS HOVEY
AMERICAN MUSEUM OF NATURAL HISTORY

A WORD OF EXPLANATION

TO THE EDITOR OF SCIENCE: May I trespass on your space for a word of explanation? A series of public lectures on human sense-organs recently delivered by me in Boston has given occasion to a number of newspaper reports. Most of these reports are entirely erroneous and misleading. None of them have been published with my sanction, but, on the contrary, quite against my wish. I am therefore not responsible for either their form or content.

G. H. PARKER

QUOTATIONS

THE SERVICE PENSION OF THE CARNEGIE FOUNDATION

AN official action taken two months ago, but only now publicly announced, by the Carnegie Foundation for the Advancement of Teaching seems to have certain ethical aspects that deserve consideration, not only from members of the teaching profession, but also from the public at large. Those aspects will, I think, become sufficiently apparent from a brief recital of the facts in the matter.

Upon its incorporation in 1906 the foundation announced that it would grant retiring allowances to teachers in accepted institutions upon two grounds—old age and length of service. The conditions relating to the old-age pension are not relevant to the present communication. The rule relating to service pensions reads as follows: "Any person who has had a service of twenty-five years as a professor, and who is at the time a professor in an accepted institution, shall be entitled to a retiring allowance"—computed in a specified manner. Between April, 1906, and November, 1909, many university teachers and many governing boards based definite plans and actions of their own upon the supposition that, so far as its resources extended, the Carnegie Foundation would do what it had announced that it would do. The expectation of a service pension was, in some cases, named among the inducements offered men who received calls to institutions upon the "accepted list" of the foundation; it was in other cases a motive for the refusal of otherwise advantageous calls to institutions not upon the foundation. In instances either known or reported to me, teachers nearing the time of eligibility for a service pension have in a great variety of ways altered their plans,

modified their domestic arrangements, made personal sacrifices, in order that, with the aid of the pension, they might be able to retire and carry through without distraction some project of study or of literary production. Some, expecting an early relief from all teaching duties, have foregone leaves of absence which they might have claimed; some have taught in summer schools or night schools who would not otherwise have done so; some have made investments or taken insurance with express reference to the time of their prospective retirement. After institutions, families and individuals have thus, for nearly four years, been permitted and encouraged by the Carnegie Foundation to be vitally influenced in the conduct of their affairs by an expectation based upon the foundation's explicit announcement, the entire system of service pensions is now abruptly abolished, "except in the case of disability unfitting" the applicant "for work as a teacher as shown by medical examination" —which, of course, is purely a disability pension.

The question whether the scheme of service pensions for professors under sixty-five and in good health was originally a wise one I do not here discuss; it is a question of policy concerning which a good deal might be said on either side. But two considerations in the matter seem so plain as to afford no ground for differences of opinion. One is that, unless the Carnegie Foundation is to be guilty of an act of bad faith it should promptly supplement its recent action by the proviso that at least all persons within ten years of the time of eligibility for a service pension, under the old rule, may still claim such pension when their time comes around. The other patent fact is that, unless so supplemented, the latest action of the foundation must hereafter render impossible any confidence in the stability of policy of that corporation. In the federal act of incorporation by which the foundation received legal entity two classes of prospective beneficiaries are specifically distinguished and equally emphasized: college teachers "who by reason of long and meritorious service *or* by reason of old age, disability, or other sufficient reason" shall be deemed entitled to pensions. The service-pension feature has similarly been especially emphasized in the public reports and explanations of policy of the president of the foundation. A body which at a moment's notice abandons one of the two purposes constituting its proclaimed *raison d'être* is equally likely to modify the other to any assignable degree.

I can scarcely suppose that any one will think it relevant to note that the foundation has always retained the power to alter its rules "in such a manner as experience may indicate as desirable." All public bodies, doubtless, have such power to amend their regulations; but it is not commonly conceived that the power can justly be exercised in such a way as to have a retroactive effect, or to nullify equities acquired or expectations reasonably aroused by virtue of the previous regulations.—Arthur O. Lovejoy in *The Nation.*

THE PRINCETON GRADUATE COLLEGE

Yesterday's decision by the Princeton trustees seems to have met the question immediately at issue in a way both happy and just. Few details are as yet published, but the main points are clear. Two gifts for the endowment of a graduate college had been offered, one apparently conditioned upon a site on or near the campus, the other contemplating a location at a distance from it. There were also questions about the control of the new institution by the academic governing body of the university. Because it was found impossible to unite the two foundations, or otherwise to reconcile the differences about administration, the larger gift was withdrawn. While regretting this, and hoping that an adjustment may yet be found, the trustees distinctly uphold President Wilson. He was right, they decide, in insisting upon a proper university control of the proposed graduate college, and upon its being absorbed into the common academic life at Princeton. Yet they distinctly refer to "dissensions" in the faculty and in the governing board which it will be the duty of the trustees to grapple with in the near future. Thus the particular dispute

is seen to be merged in the larger and general question.

What that is at Princeton, it is perfectly well known. President Wilson has left his attitude in no doubt. He is for the freest and fullest play of the democratic spirit in colleges, and as a means of securing it at Princeton urged the system of dormitories in which all the students should live. This involved the abolition of the expensive and exclusive clubs which have been so marked a feature of life at Princeton. But though the faculty approved a proposal which many considered revolutionary, the trustees have thus far declined to give their assent to it. This is clearly the question about which the "dissensions" have sprung up, involving as is known a great deal of bitter feeling with rumors that President Wilson would be forced to resign.—New York *Evening Post.*

AN attitude was taken towards Mr. Proctor's generosity in regard to Princeton's long-professed hope, he was catechized in such a manner in regard to what he was attempting with commendable forbearance to do for his Alma Mater, that, as Mr. Pyne said in the statement he felt it necessary to make public, "From the start his generosity has met with such an extraordinary reception, his motives have been so misconstrued, his patience has been so sorely tried that self-respect has at last demanded the withdrawal of his princely gift. Thus at least $900,000 has been lost to Princeton by the treatment he has received."

The recent meeting of the Board of Trustees closed one act of this remarkable drama —with an anti-climax. It has by no means settled the matter. We have merely lost a Graduate College, with very little chance now of getting one. But the controversy over the issues raised seems only to have begun. The object of the recent meeting of the board was to call a truce. . . . To state, therefore, as most of the newspapers did, that Mr. Pyne and the other members of the board who were not in accord with the treatment by the Committee of Five of Mr. Proctor's offer were won over from their position is about as far from the truth as it could be. They stand exactly where they stood before, only more staunchly so, more indignantly so, and have expressed the desire to have this clearly recognized. —Jesse Lynch Williams in *The Princeton Alumni Weekly.*

SCIENTIFIC BOOKS

New Manual of Botany of the Central Rocky Mountains (Vascular Plants). By JOHN M. COULTER. Revised by AVEN NELSON. New York, American Book Company. January, 1910.

When the present reviewer landed in America, in 1887, his first purchase was a copy of Coulter's "Manual of Rocky Mountain Botany," at that time rather recently published. In his subsequent wanderings over the state of Colorado, this volume was his inseparable companion, proving itself a most serviceable hand-book to the flora of the region. In those days it was innocently supposed that the Rocky Mountain flora had been nearly all described, and if a plant did not altogether agree with any of the descriptions, it was generally assumed that the species must be variable. It was not possible for the worker in the field to discover that numerous species, supposed to be identical with those of distant regions, were in reality quite distinct.

About the year 1894 there began a new era in the study of Rocky Mountain plants. The material in the herbaria was scrutinized anew, and many collections were made in different parts of Montana, Wyoming and Colorado. Presently new species began to be described, and new generic names proposed. The activity increased until the output was astonishing, and this has continued down to the present time. The old manual no longer represented the knowledge of the day, and a new edition was planned. This was placed in the hands of Professor Aven Nelson, of the University of Wyoming, who has been a much larger contributor to the knowledge of Rocky Mountain plants than all the other residents of that region combined. The appearance of the new book was looked forward to with extreme interest and impatience by students of this flora, and now that it is out, many are the discus-

sions and investigations it is stimulating. The author, as we learn from a private letter, does not for a moment consider that he has said the final word on the subject, but hopes that this presentation of his results up to date will prove of service, and especially will cause others to study the subject in the field, and gradually put it on a firmer basis. In this he is wholly justified, and whatever we may think about particular disputed matters, we must recognize that he has done an immense service, in the first place by his researches, and in the second by presenting them in a compact and convenient form, so that all may make use of them. No one, in future, will pretend to study the plants of Colorado or Wyoming without a copy of Nelson's "Manual" by his side.

I have had the curiosity to count the number of species admitted as valid in the new manual, which were undescribed at the time of publication of the first edition, in 1885. The number is 787, about 28 per cent. of the whole flora. This count includes all specific names first published since 1885, but does not include varietal names proposed prior to that date, and given specific standing later. Of the 787, no less than 244 were proposed by Professor Aven Nelson himself; 152 are by Dr. Rydberg, of the New York Botanical Garden and 148 by Dr. E. L. Greene, now of the U. S. National Museum, but at one time a resident of Colorado. The other authors are as follows: Elias Nelson, 20; Jones (of Utah), 18; Scribner (grasses), 17; Vasey, 15; Coulter and Rose (Umbelliferæ), 15; Bailey (mainly *Carex*), 13; Osterhout (of Colorado), 12; Small, 11; Eastwood (formerly of Colorado), 10; Britton, 10; Wooton (of New Mexico), Nash and Sheldon, each 5; Goodding (of Wyoming), Trelease and K. Schumann (Cactaceæ), each 4; Sargent, J. G. Smith, Bicknell, Piper and Porter, each 3; A. S. Hitchcock, Beal, Vasey and Scribner, O. Kuntze, Howell, Robinson, Ramaley, Blankinship (of Montana), Henderson and Leiberg, two each; Underwood, Maxon, D. C. Eaton, Macoun, Nash and Rydberg, Scribner and Williams, Holm, Fernald, Bebb, Ball, Coulter and Fisher, Canby and Rose, Pax, Huth, Cockerell, Vail, Eaton, Coulter, Wiegand, Holzinger, Nelson and Cockerell, Mackenzie, Pammel, E. G. Baker, Léveillé, Coulter and Evans, Wight and Wright, one each.

Thus the three principal workers have contributed 544 between them, 65 have been published by miscellaneous residents of the region covered by the manual, 168 by American botanists not resident in the Rocky Mountains and ten by European botanists.

After all this, the reader may be astonished to learn that Nelson's work is planned on what are called "conservative" lines, *i. e.*, those of *not* conserving the names of "critical" or doubtful species. The number of species accepted as valid is 2,733, while no less than 1,788 specific names are rejected as synonyms or insufficiently known. Many of those latter were proposed by Professor Nelson himself, more by Rydberg and Greene. In addition to the large number rejected, very many are not mentioned at all, presumably because the author did not possess specimens. Most of these latter are "critical" forms, but by no means all. Thus *Woodsia mexicana*, for which Rydberg cites five Colorado localities, is absolutely ignored, and there are many instances only a little less striking. It is stated in the preface that the flora includes the northern half of New Mexico, but we miss not only the rarer endemic plants of that region, but many of the commonest roadside flowers, such as *Sphæralcea fendleri, Commelina dianthifolia* and *Cosmos*. On the other hand we find a few species of southern New Mexico, as *Rosa stellata* and *Polemonium pterospermum*.

Rydberg, in his recent (1906) "Flora of Colorado," recognized 2,912 species, a number somewhat greater than Nelson admits for his much larger area. As is well known, Rydberg treats many of the minor or critical forms as full species, which of course accounts for the difference. The quite recent (1909) French edition of Schinz and Keller's "Flora of Switzerland" includes 2,534 species of vascular plants. When we consider the much smaller area of Switzerland, and the greater variety and distinctness of the life-

zones in the Rocky Mountains, it would seem that the latter might be expected to have twice as many species. Switzerland has, of course, been more thoroughly investigated, but the large number of species given is not due to the inclusion of the "critical" forms, for the authors tell us in the preface that these are all to be given separately in a subsequent volume, the "Flore Critique." In the 1909 volume the species are supposed to be such in the ordinary sense, and a special mark is appended to those (and they are very numerous) of which segregates are known, the account of these being promised in the later work.

There is no doubt that the separation of the ordinary from the "critical" flora, after the manner of Schinz and Keller, is convenient to the numerous class of botanists who are not specialists in taxonomy. Professor Nelson's work corresponds to the Swiss volume before me while Dr. Rydberg's book on the plants of the same region, expected in about a year, will really be a "Flore Critique," at least to a considerable extent. American workers are at present roughly divided into two groups, of which a modern European botanist would say that one failed to discriminate the lesser types, many of which are of the highest interest from a biological standpoint, while the other, recognizing minor segregates, treated them all as species, without any attempt to indicate in the nomenclature their various kinds and degrees of relationship to the species of the older school. We venture to hope and believe that at length a middle ground will be found in a system of classification more like that of advanced European workers, which permits the presentation of the most minute details, without seriously disturbing the current conception of species.

T. D. A. COCKERELL

Umwelt und Innenwelt der Tiere. Von J. VON UEXKÜLL, Dr. med. hon. c. Berlin. Verlag von Julius Springer. 1909. 8vo, pp. 259.

The bold and original investigations of von Uexküll have culminated in his "Umwelt und Innenwelt der Tiere"; culminated, not because there are reasons to suppose that this will be his last contribution to science, or perhaps even his best, but because he has synthesized into a coherent whole the results of earlier work, and with the addition of fresh materials, and maturer judgments, has sketched in the outlines of a reformed biology.

Large sections of the book must be left to those who have made certain protozoa, cœlenterates, annelids, molluscs, crustaceans and insects, subjects of prolonged study, yet as a whole, the work should appeal to every biologist, no matter what group of animals or facts he knows best. It is these matters of general appeal that concern us.

First of all, a living thing is neither a bundle of anatomical details nor a collection of physiological processes, nor both of these together, for things that live, live in an environment. To cultivate either anatomy or physiology exclusively is as futile as the study of environments with all the animals left out, for the business of the biologist is to know, not merely structure or function, but what the vital machinery is, how it works and the circumstances under which the work is done.

The organism, von Uexküll teaches, must be studied, not as a congeries of anatomical or physiological abstractions, but as a piece of machinery, at work among external conditions. Our analyses, so far, have been by no means exhaustive, for we have largely neglected the fact that the organism makes its surroundings. It is true that environment includes the sum total of everything outside the individual, and, within these limits, is the same for all living things. Yet this is wholly misleading, for environment is both essential and unessential, and only the former counts practically in the shaping of biological destinies. The shark, the jellyfish and the pluteus, that swim side by side at the base of a wharf-pile, under uniform conditions of salinity, temperature, light and mechanical agitation, have each a different effective environment, and to this extent live in different worlds. Only when the receptors, through which external conditions make their appeal, are alike, are the outside conditions similar, but as the stimulated organs vary, so do the

several environments. Even within the same group these differ.

One need but glance at the pictures of Holbein to realize that the world in which he lived was far richer than our own. The simplest things are endowed by him with a reality that makes the objects we see pale.

The embryologist who has reared the eggs of the oyster, the starfish and the sea-urchin, within the same tumbler of sea-water, each into its proper larva, can testify strongly in favor of von Uexküll's view. Nevertheless, it does not follow that the organism which by selection makes its environment, is the all-important thing. Our author himself does not contend that it is, but there are those who do. It may not be amiss, therefore, to point out that an animal adapted to an environment of which factors *A*, *B*, *C* and *D*, constitute the practical portion, may be transferred suddenly to surroundings in which *A* is represented by $A+1$; *B* by $B+1$; *C* by $C+1$; and *D* by $D+2$. If $A+1$ can serve for *A*, the substitution is made, and similarly $B+1$ and $C+1$, may take the places, respectively, of *B* and *C*. On the other hand, $D+2$ may be beyond the range of the organism unless introduced to it, through the medium of $A+1$, $B+1$ and $C+1$. If under these conditions $D+2$ is selected, it follows that the new environment has made the animal over, and von Uexküll's dictum, therefore, can be enlarged to read, The organism makes the environment, and, reciprocally, the environment makes the organism.

The discussion of the environment leads by a natural step to a subject sadly in need of sunshine and fresh air.

Dictionaries define "organization" as "specifically the constitution of an animal or vegetable body, or of one of its parts," and many biologists use the word in this sense. Were they consistent, no one would object, or be the worse for the substitution of "organization" for "structure," but the word is as versatile as the men who use it, and the synonym transforms before our eyes into a brief formula for that unity in action which comes with transcendent complexity. Not only this, but many, gifted with the power of making things more difficult than they really are, would have us believe that the organization is inside the thing organized!

The discovery that organized things come from eggs has led us to look in eggs for the method of origin. The creatures that come from eggs, however, are organized, not because they have a particular structure, or form, but because the parts that compose them are wonderfully related. One of the most beautiful examples of organization in nature is the bee-hive, a thing marvelously related to its environment, and hardly less marvelous abstractly, for its members act not only for their own welfare, but especially for that of the community and the race. It would be futile to study serial sections for this organization, since only honey, wax and the fragments of bees would greet the investigator's eyes. No less futile is the search in eggs, for organization is not a material thing, but the sum of the interrelations between material things. From this standpoint, reversals of polarity or symmetry are in the same category with the evolutions of a company of soldiers, and, like the orderly facing about of a well-drilled body of infantry, are possible only under conditions dependent on structure, yet themselves not structural. Physiological interrelations do not exist in space. As well try to dissect the digestion out of the duodenum, as to search with anatomical methods for organization, in this sense, in the egg!

If the point of view presented seems wholesome, the impetus so gained, in favor of von Uexküll's opinions, is nevertheless insufficient to carry us over the vitalistic bumper which he has thrown across the biological roadway. The argument is this: Living things are machines, but they are not all machinery. The hand and foot, the arm and leg, the stomach and heart, are machines, but they come from the egg, and the power to differentiate machines is itself super-mechanical. Reproduction, regeneration and certain kinds of regulation, occur in no machines known to man, and hence any machines that reproduce, regenerate or regulate are to this extent "übermaschinelle."

The logical weakness of this argument is at once supported by the circumstance that the protoplasm which differentiates the machinery is a liquid, and as all stresses and strains in a fluid are instantly equalized, liquid machines are physical impossibilities. The protoplasm of the egg is, therefore, no machine, and is forever beyond the reach of mechanical investigations. Physiology, anatomy, chemistry and physics are all powerless to grapple with this problem. The essence of a living thing is that it is vital, and this attribute, if accessible to the human intellect at all, can be understood only by the aid of "reine Erkennungslehre."

Whether vitalism will triumph ultimately, is one of the many things that most biologists do not know, although von Uexküll considers victory inevitable. Lack of philosophical insight is held responsible for the bankrupt condition of our science, but however this may be, to restore confidence in biological currency by means of an inflation of vitalistic values seems a doubtful undertaking even if liquid machines are impossible. But is protoplasm a liquid?

The naked amœbæ are the most fluid of all animals, nevertheless their outer layers are visibly different from the interior, and there is every reason to believe that the ectosarc subserves many of the functions performed by the firmer boundaries of other cells. Among these functions is that of being a barrier which prevents the animal from becoming infinitely diluted in the medium in which it lives. Furthermore, the ectosarc, like the cell membrane, allows certain substances to pass in and out, and in this way insures differences in chemical composition between the amœba and its surroundings, while at other times it is the gate through which the equalization of differences is brought about. As long as protoplasm does not exist abstractly, but always occurs in nature behind a barrier that makes possible interrelations with the environment, and prevents fusion and identity with it, arguments based on a liquid as it isn't, can have no bearing on the case of vitalism *vs.* mechanism.

We will suppose, however, that the optical differences between the ectosarc and the endosarc are illusory; that the outer layers of the most fluid of all amœbæ are not physiologically the equivalents of cell-membranes; and finally that we are in reality dealing with liquids entirely uniform. We will endow these microscopic Frankensteins with life. Are they machines?

Abstractly—no; concretely—yes, for our imaginary creatures exist in an environment, and interaction between the two is the one condition under which life is possible. As long as such interaction occurs, as long as metabolism takes place, we have differences of potential, stresses and strains; as long as anything happens, and life is a happening, we have a mechanism, a machine, but the machinery is neither the amœba nor the environment, but the two together. Von Uexküll's own contention that an organism devoid of environment is an absurdity, harmonizes so completely with this criticism, that it is difficult to see how the road which he has traveled could ever have led him into the vitalistic man-trap.

To make a good book, however, does not require infallibility. Thought, honesty and clearness are the necessary ingredients, and a writer who commands these fertilizes the minds of his readers, and where wrong, furnishes the materials for the correction of his own mistakes. Even though von Uexküll seems to have failed in some of his undertakings, he is nevertheless an author thoroughly worthy to be read.

OTTO C. GLASER
UNIVERSITY OF MICHIGAN

Handbuch der Klimatologie. Band II., Klimatographie. I. Teil, Klima der Tropenzone. Dritte, wesentlich umgearbeitete und vermehrte Auflage. Von Dr. JULIUS HANN. 8vo, pp. x + 426, figs. 7. Stuttgart, J. Engelhorn. 1910. Preis 14 M.

The first part of the second volume of the third edition of Hann's monumental work—revised, enlarged, up to date—the unique storehouse of climatological fact and description; the indispensable reference book for all who

deal in any way with the science of the earth's atmosphere; a book which has laid the whole scientific world under a debt of gratitude to its author, impossible to overestimate.

R. DeC. Ward

SPECIAL ARTICLES

EARTH MOVEMENTS AT LAKE VICTORIA IN CENTRAL EAST AFRICA

The profound significance for Central East Africa of the fall of Omdurman in 1898 has been strikingly brought out by subsequent scientific publications of the Egyptian Survey Department. Captain H. G. Lyons, late the eminent director general of that department, and now occupying the newly established chair of geography at the University of Glasgow, published in 1906 an extended monograph upon the Nile River and basin.[1] This volume, which is issued by the finance ministry, compels admiration as much by its exhaustiveness as by its orderly arrangement and lucid presentation of the facts. Through setting forth in a well-digested summary the scientific results secured by early and late explorers and scientific travelers, and by including a full bibliography of the geography and geology of the district, the work has been made authoritative and indispensable.

Those who have not already interested themselves in the region will be surprised to learn how many observing stations supplied with water gauges, have been established upon the Upper Nile and its tributaries, and of the almost continuous series of careful gauge readings extending over a full decade.

The very interesting conclusions on the basis of these readings, which were foreshadowed in the monograph above cited, are contained in a very recent report of the Survey Department.[2] The conclusion to which Captain Lyons is forced is that the gauges have registered oscillations of level of the ground about Lake Victoria. Upon the northern and northeastern shores of this lake three gauges were established—one at Entebbe on the northwest shore, another at Jinja on the north shore where the Nile leaves the lake, and one at the head at Kavirondo Gulf near the railway terminus on the northeast shore. Although all three gauges have been moved since they were first established, and though there are some gaps in the records, yet in the main it is true that daily gauge readings are available from three widely separated stations since September 30, 1898.

Study of the monthly averages of these readings has shown with much probability that in October, 1898, a sinking of the land at Entebbe began and continued during 1899. It was most marked during August and October of that year. At the end of 1900 and during the early months of 1901, a slight elevation seems to have occurred, though in May and June following a renewed sinking took place. This movement on the northwest shore of the lake seems not to have been participated in by the land farther to the eastward. These local movements, extending as they do over several months, can not be explained by wind effects.

From November, 1901, to February, 1902, the Jinja gauge curve was on the whole rising, while those at Entebbe and Kisumu were falling steadily. Again in December, 1902, the Jinja curve was steady, while those of Entebbe and Kisumu were rising, but in February, 1903, the case was reversed. Subsequent to these later dates the gauges have shown no noticeable discrepancies which could be attributed to a recurrence of oscillations of level until in 1908, when at Jinja the lake level fell 14 inches between February 5 and 19, the change of level at each of the other two stations being only an inch and a half.

To quote Captain Lyons, all the available information "points to the frequent and recent differential movement of great blocks of the country." Following Herrmann he states:

> The movements of upheaval have acted along NNE–SSW directions, and the intensity seems to

[1] "The Physiography of the Nile River and its Basin," Cairo, National Printing Department, 1906, pp. 411 and numerous maps.

[2] "The Rains of the Nile Basin and the Nile Flood of 1908," by Captain H. G. Lyons, F.R.S., Survey Department Paper No. 14, Cairo, 1909, pp. 69, pls. 8.

have been most marked in the southwestern part of the area, not far from the Virunga group of volcanoes of Lake Kivu. Five main blocks may be recognized which are separated by troughs; the islands of the western coast of the Victoria Lake present the first of these, while three others range one behind the other between the lake shore and Valley of the Kagera, and in the intervening troughs lie lakes, swamps or slowly flowing rivers; the fifth forms the Ruanda Plateau west of the Kagera. The edges of these blocks have as yet been but little modified by weathering, so that the latest movements would appear to be comparatively recent.

The formation of Victoria Lake is shown to be due to mutual adjustments among these earth blocks, separated as they are by great faults running in the directions N.–S., E.–W., NE.–SW., and in the area south of the lake also NW.–SE. Again quoting Lyons:

> Large masses, many kilometers long, have been raised, lowered or tilted, and in the valleys formed along the fracture lines, the main drainage lines of the district run. Lake Victoria itself is outlined by such fractures.

All writers seem to agree upon the dominance of block movements of the crust in determining the relief of Central East Africa, and it is therefore interesting to learn from these newer studies of the Nile Basin, that the great river itself between Korusko and Aswan (Assouan) wherever crystalline rocks occur in its neighborhood, takes directions parallel to the neighboring intrusive dikes.

While the region is one of earthquakes, the movements disclosed by the series of gauge readings would seem to be of the slower type, and it would be of great interest to know whether the main periods of change of level correspond in time to any subterranean rumblings such as are now being reported from so many unstable districts and are called *brontidi*. As compared with the crustal movements which are revealed by gauge readings within the Laurentian Lake district of North America, these African observations differ in being more rapid, and, further, in indicating reversals in the direction of movement. They similarly, however, point the moral that the sensitiveness of great inland bodies of water, when employed as precise levelling instruments, has never been properly appreciated.

WM. H. HOBBS

UNIVERSITY OF MICHIGAN,
ANN ARBOR,
January 29, 1910

THE FORTY-FIRST GENERAL MEETING OF THE AMERICAN CHEMICAL SOCIETY. II

DIVISION OF FERTILIZER CHEMISTRY

F. B. Carpenter, *Chairman*
J. E. Breckenridge, *Secretary*

The Direct Estimation of all Intensities of Hydrogen Ion Concentration by Means of Di-nitrohydrochinone: LAWRENCE J. HENDERSON.

The Nitrogen Thermometer from Zinc to Palladium: A. L. DAY and R. B. SOSMAN.

Laboratory Methods for Organic Nitrogen Availability: C. H. JONES.

The alkaline permanganate and pepsin methods for determining organic nitrogen availability as used in the Vermont Experiment Station laboratory are described. Results by these methods on fifty-one high- and low-grade animal and vegetable ammoniates now on the market are tabulated and briefly commented upon.

Both methods have been used at the Vermont Station on officially collected commercial fertilizers for the past twelve years. Tables were shown giving the results of this work.

The writer concludes that the alkaline permanganate method, while empirical, is nevertheless valuable to eliminate quickly from a large number of samples those of questionable availability which may then be tested by the longer pepsin process and qualitatively to show more in detail the nature of the nitrogen source.

The following papers are reported by title:

Influence of Chemistry on Agriculture: F. B. CARPENTER. (Chairman's address.)

Concerning After Effects of Certain Phosphates on Limed and Unlimed Lands: H. J. WHEELER.

New Method for Filtrating Insoluble Phosphoric Acid: R. H. FASH.

Facts Brought Out Regarding Uniform Analytical Methods for Phosphate Rock through the Recent Work of the National Fertilizer Association's Committee: C. F. HAGEDORN.

Neutralization of the Ammonium Citrate Solution: J. M. MCCANDLESS.

Note on the Determination of Phosphoric Acid by the Official Volumetric Method: F. B. CARPENTER.

The Improvement of Analytical Processes: W. D. Richardson.

The Cost of Available Nitrogen in Commercial Fertilizers: E. B. Voorhees.

Bacteriological Methods for Determining the Available Nitrogen in Fertilizers: J. G. Lipman.

Notes on the Recovery of Waste Platinum: A. W. Blair.

Method and Materials used in Soil Tests: H. A. Huston.

Accuracy in Taking and Preparing Mixed Fertilizer Samples: F. B. Porter.

The Determination of Inferior Ammoniates in Commercial Fertilizers: John P. Street.

Reports of Committees: Paul Rudnick, for the Committee on Nitrogen; G. A. Farnham, for the Committee on Phosphoric Acid; J. E. Breckenridge, for the Committee on Potash; F. B. Veitch, for the Committee on Iron and Aluminum.

DIVISION OF AGRICULTURAL AND FOOD CHEMISTRY

W. D. Bigelow, *Chairman*
W. D. B. Penniman, *Secretary*

Analyses of Maize Products: Edward Gudeman.

Analyses of maize products during the last five years, showing changes in composition of these products, especially as to ash, acidity, sulphites, arsenic and metallic impurities. Discussion of the effect of federal and state food acts on the composition of these products.

The Influence of Microorganisms upon the Quality of Maple Syrup: H. A. Edson.

Studies upon the microscopic flora of maple sap during the past three years have shown that the sap within the vascular bundles of the tree is free from microscopic organisms, but that the tap hole, spout and bucket afford favorable lodging places for the development of microscopic life. With the advance of the season as the days become warmer and the freezing nights less frequent and less severe, yeasts, mould spores and bacteria appear in the sap in increasingly great numbers. By isolation and inoculation experiments specific groups of organisms have been shown to be the cause of the various types of abnormal sap characteristic of the late runs, such as green, red, milky and stringy sap. Inoculations with pure cultures in first run material yield syrup of inferior color and flavor such as is frequently produced from the last run.

Sap of the last run when drawn under conditions to exclude heavy inoculations with micro-organisms yields syrup of superior color and flavor which is in striking contrast to that produced from sap drawn in the usual manner from the same tree at the same time.

Analyses and Composition of Milk and its Products: Edward Gudeman.

Analyses of milks from different localities and at different seasons. Discussion of change of ratio between fat and solids not fat, and influence on composition of concentrated milk products, evaporated and condensed milks and milk powders. Influence of heating milks of various composition during pasteurization, sterilization and concentration.

The Composition of Milk: Hermann C. Lythgoe.

Analyses of known purity samples of milk show that the milk sugar is practically constant while the other constituents are variable. This fact may be used in detecting skimming as well as watering. After making the fat and total solids determinations the proteids may be calculated from either by Van Slyke's or Olson's formulæ, respectively. If the milk has been skimmed the calculated proteids will be too low and if the sugar is calculated by difference (assuming an ash content of 0.7 per cent.) it will be too high. Experience has shown that these calculated figures for milk sugar vary between 4.2 per cent. and 4.8 per cent. in pure milk. If the milk has been watered they will be low, while if the samples have been skimmed the calculated sugar will be high.

Some Applications of Electricity to Apparatus and Laboratories for Water Analysis: Ellen H. Richards.

The advantage of using electricity as a source of heat for making distillations, evaporations and running ovens and incubators is pointed out. The tungsten lamp is useful as a uniform source of light for color determinations. Electricity makes possible the use of the ventilating fan and the vacuum cleaner.

It is estimated that electricity is economical for laboratory uses if it can be had at a cost of four cents per kilowatt hour. The cost may be reduced to this figure by any establishment using exhaust steam for heating.

It is so great a saving of labor and adds so much to the general efficiency of the laboratory and accuracy of its results, that it can not be considered dear at twice that cost.

Pentosans in Soil: Oswald Schreiner and Edmund C. Shorey.

Nearly all soils when treated with boiling 12

per cent. hydrochloric acid yield some furfurol, indicating the presence of some pentosan body.

Ten soils containing widely different amounts of organic matter (organic carbon from 0.31 to 27.1 per cent.), were subjected to the official method for the determination of pentosans and figures were obtained which varied from 0.005 to 0.275 per cent. No relation between the total carbon and pentosan carbon was apparent, the soil containing 27.1 per cent. organic carbon yielded 0.109 per cent. pentosan, while a soil containing 6.99 per cent. organic carbon yielded 0.275 per cent. pentosan. From this latter soil there was obtained by precipitating a sodium hydrate extract with alcohol a dark-colored, gummy precipitate which yielded a pentose sugar on hydrolysis with acid. An osozone obtained from a solution of this sugar had a melting point of 161° C., and the solution yielded a small amount of the characteristic crystals of the compound of xylose with cadmium.

The following papers are reported by title:

Relationship between Bacteriological and Chemical Findings in the Examination of Milk, Water and Food Products: S. C. PRESCOTT.

Microscopical Examination of Spices and Food Products: A. L. WINTON.

The Determination of Cane Sugar by the Use of Invertase: C. S. HUDSON.

Sampling of Sugar: C. A. BROWNE.

The Composition of Canned Peas and Lima Beans: W. L. DUBOIS.

Composition of Cold Water Extracts of Beef: P. F. TROWBRIDGE and C. R. MOULTON.

Phosphorus in Flesh: P. F. TROWBRIDGE.

The Cold Storage of Apple Cider: H. C. GORE.

The Value of Peaches as Vinegar Stock: H. C. GORE.

The Composition of Vinegars formed from the Ciders of Different Varieties of Apples: H. C. GORE and ALICE L. DAVISON.

The Examination of Vinegar: R. W. BALCOM.

The Estimation of Glycerine in Meat Preparations: F. C. COOK.

A Comparison of Meat and Yeast Extracts of Known Origin: F. C. COOK.

The Working Efficiency of a Constant Temperature Laboratory for Polarizing Sugars: C. A. BROWNE.

The Separation of Colloids from Solution by Freezing and some Practical Results: W. D. RICHARDSON.

The Use of the Refractometer in Detecting Added Water in Milk: P. H. SMITH and J. C. REED.

The Stability of Butter Fat: E. B. HOLLAND.

The Influence of the Method of Drying on the Non-volatile Ether Extract of Spices: A. LOEWENSTEIN and W. P. DUNNE.

Sampling of Ground Spices: HARRY E. SINDALL.

Delicacy of the Ferric-chloride and Jorrissen Reaction for Salicylic Acid: H. C. SHERMAN and A. GROSS.

The Identification of Mixed Coloring Matters in Foods: S. P. MULLIKEN.

Factors which Influence the Digestion of Food: P. F. TROWBRIDGE.

Aeration a Factor in the Purification of Water: W. W. SKINNER and G. W. STILES.

The Influence of Environment on the Composition of Wheat: J. A. LECLERC and SHERMAN LEAVITT.

Rate of Acceleration of Plant Growth with Increase in Temperature: FRED W. MORSE.

The Stimulation of Premature Ripening by Chemical Means: A. E. VINSON.

The Development of Catalase in Lower Fungi: ARTHUR W. DOX.

Wax of Candelilla or Mexican Wax Plant: G. S. FRAPS.

Formation of Ammonia Soluble Organic Matter in Soils: G. S. FRAPS and N. C. HAMMER.

Nitrates in Pineapple Soils: A. W. BLAIR.

Observations bearing upon the Practicability of Certain Chemical Methods of Testing Soils: H. J. WHEELER.

The Oxidizing Power of Soils: M. X. SULLIVAN and F. R. REID.

Oxidation Effects of Manganese Salts in Soils: J. J. SKINNER.

Variation in Methoxyl in Soil Organic Matter: EDMUND C. SHOREY and ELBERT C. LATHROP.

Relation of the Active Phosphoric Acid of the Soil to Deficiencies for Phosphoric Acid as shown in Pot Experiments: G. S. FRAPS.

Puren Bases in Soils: OSWALD SCHREINER and EDMUND C. SHOREY.

The Effect of Certain Plants upon the Nitrate Content of Soils: T. L. LYON and J. A. BISSELL.

Chemical Changes produced in Soils by Steam Sterilization: T. L. LYON and J. A. BISSELL.

The Detection of Deterioration of Corn and Corn Meal with Special Reference to Pellagra: C. L. ALSBERG and O. F. BLACK.

Some New Formulas for the Determination of Dextrose, Dextrine and Maltose: H. E. BARNARD and W. B. MCABEE.

A Study of the Keeping Qualities of Crushed Fruits, Fruit Syrups and Sugar Syrups: H. E. BARNARD and I. L. MILLER.

The Composition of So-called Temperance Beers: H. E. Barnard.

The Efficiency of Land Plaster in Preventing the Loss of Ammonia in Manures: Wilfred W. Scott.

BIOLOGICAL CHEMISTRY SECTION

In Joint Session with the American Society of Biological Chemists

S. C. Prescott, *Chairman*

The Phosphorus of the Flat Turnip: Burt L. Hartwell and Wilhelm B. Quantz.

It was found that the percentage of phosphorus in the dry matter of flat turnips was influenced by the amount of available phosphorus in the soil upon which the crop was grown. This led to the attempt to ascertain if any particular class of the phosphorus compounds was influenced principally.

About 10 per cent. of the phosphorus of the dry turnip was soluble in 95 per cent. alcohol, and about 70 per cent. was dissolved subsequently in 0.2 hydrochloric acid. Fifty to 70 per cent. of the phosphorus in this extract was precipitable by a molybdenum mixture containing only a small amount of free nitric acid. In fresh turnips about 80 per cent. of the total phosphorus was found in the somewhat colloidal aqueous extract, and over four fifths of this was directly precipitable by magnesium oxid and by the official mixtures of molybdenum and magnesium.

Nearly all of the phosphorus in turnip juice passed through a dialyzer. When added to a standard solution of sodium phosphate, the colloidal matter from within the dialyzer interfered with the complete precipitation of the phosphorus by the molybdic method. Hydrochloric acid added to turnip juice itself to the extent of 0.2 per cent. made it possible, after filtration, to precipitate nearly all of the phosphorus directly from the filtrate. Practically no phosphorus in phytin was present in the juice. It appears as if four fifths of the phosphorus of fresh flat turnips is in soluble compounds and exists mainly as so-called inorganic phosphorus.

Ratio of Plant Nutrients as affected by Harmful Soil Compounds: Oswald Schreiner and J. J. Skinner.

Results of a comprehensive study of culture solutions with and without dihydroxystearic acid, a harmful compound isolated from soils, were reported. The culture solutions comprised all possible ratios of the three principal fertilizer elements: phosphate, nitrate and potassium, varying in 10 per cent. stages. The culture solutions were changed every three days and analyzed, the remaining composition and ratio of the above fertilizer elements being thus determined. In this way the effect of the plant and of the dihydroxystearic acid on the composition and ratio could be determined. The triangular diagram is used in this work and makes possible the intelligent handling and presentation of the results.

Some of the principal results were as follows: The plant growth and absorption were greatest in the solutions containing all three fertilizer elements, but not in equal proportions, the greatest growth and greatest absorption being found in the region below the center in the triangle. The dihydroxystearic acid had the effect of shifting this region of greatest growth toward those ratios higher in nitrogen. Although absorption was greatest in this region, the ratios suffered the least change; the greatest change is produced in those ratios most removed from this normal region.

The harmful soil compound inhibited growth in all the solutions, but was the most harmful in those ratios not well suited for plant growth and least in those best suited for plant growth. Moreover, it is less harmful in the presence of those ratios mainly phosphatic or potassic and this effect is also associated with a higher nitrogen removal. The quantity of phosphate and potash removed was less in the presence of this compound. The investigations tend to throw much light upon the relations between plant growth, absorption, fertilizer action and influence of organic compounds.

Concurrent Oxidizing and Reducing Power of Roots: Oswald Schreiner and M. X. Sullivan.

The roots of growing plants, such as wheat, have the power to oxidize alpha-naphthylamine, benzidine, phenolphthalin, aloin, guaiac, pyrogallol, etc. When indicators like alpha-naphthylamine and benzidine are used, the colors due to oxidation are most intense on the region of the root where growth is most active, the most marked oxidation showing by a distant band of color just back of the root cap. Then comes a practically colorless zone and then a colored zone, the color becoming less intense toward the upper part of the root. Wheat roots grown in sodium selenite neutralized by hydrochloric acid reduce the selenite with a pink deposit of selenium upon the root. This deposit is most marked a short distance back of the root cap just back of the

region of greatest oxidative power, and appears there first. The points of emergence of the secondary roots also show the color strongly. The reducing power is more active in the young and vigorous roots. Roots killed by being dipped in boiling water have no reducing action. Roots in non-neutralized sodium selenite have little, if any, reducing action. In the main, with increased oxidizing power of the wheat root upon aloin, there is an increased reducing power upon neutralized sodium selenite. Potassium iodide in certain concentrations, however, retards oxidation but does not affect the reducing power and may indeed increase it.

The Cause of Depression produced by Molasses: J. B. LINDSEY.

Experiments were outlined which had been carried on during the past year which showed conclusively that molasses prevents digestion. Many experiments with food molasses added to different sorts of mixtures for cattle, sheep and horses have been tried and it has been found a marked depression was produced by it. The reason for this is not exactly clear although many theories have been advanced to explain it.

Cornin, the Bitter Principle of Cornus Florida: EMERSON R. MILLER.

The root bark gives best yield. Carpenter considered the bitter principle to be an organic base. The compound separated by Geiger had a slight acid reaction. In pure condition it is perfectly white, has neither basic nor acid properties, is extremely bitter and crystallizes in fine silky needles or beautiful rectangular plates, according to conditions. Melting point 181° C.

Readily soluble in water, sparingly soluble in cold alcohol or cold acetone, but is dissolved to a considerable extent by these liquids at the boiling temperature. Almost insoluble in ether, chloroform, benzole, petroleum ether and acetic ether. Sparingly soluble in benzole or acetic ether at the boiling temperature.

Contrary to Geiger's statement its aqueous solution does not form a precipitate with either silver nitrate or lead subacetate.

Tested for nitrogen with soda-lime or metallic potassium it gave negative results.

An aqueous solution after standing some time assumes color and reduces Fehling's solution. By heating with a little alkali or acid it reduces Fehling's solution at once. It also reduces ammoniacal solution of silver nitrate and bismuth subnitrate in the presence of an alkali, and responds to Pettenkofer's test for glucose. An aqueous solution does not form a precipitate with phenylhydrazine hydrochloride, but on heating yields a yellowish red precipitate.

The average of ten analyses gave C = 52.49 per cent.; H = 6.17 per cent. Computed for the formula $C_{17}H_{24}O_{10}$, C = 52.57 per cent.; H = 6.18 per cent. A molecular weight determination by the freezing point method gave 377. The above formula requires 388. The average of two tests for methoxyl gave 7.48 per cent. One OCH_3 requires 7.98 per cent.

Cornin thus appears to be a glucoside whose molecule contains the glucose nucleus and, so far as determined, is represented by the formula $C_{16}H_{21}(OCH_3)O_9$.

The Selective Antiseptic Action of Copper Salts: ALFRED SRINGER.

Last year I found a certain Cincinnati "certified milk" contaminated with traces of copper salt, which in some cases, though containing only one part in two millions, decidedly affected the normal sequence of fermentative action and made the milk a better medium for the growth of certain molds. In the course of my experimentation I found that the copper salts were highly selective, being most efficient in inhibiting the putrefactive germs, as evidenced by tests made with egg albumin, blood albumin, meat and other nitrogenous substances, with and without the addition of copper salts. These results may be caused either by the copper salts preserving the substances in their original condition, or splitting them without the formation of odorous compounds or dissociating the odorous compounds themselves into non-odorous ones.

It seemed to me that some light might be thrown upon the action of these salts by experimenting with copper treated eggs and then placing them in an incubator. In the first series of experiments I completely submerged many eggs in a cupric sulphate solution and check ones in distilled water. Those in the distilled water kept about two months, the others after a year's time have not become foul. When, however, eggs which had been completely submerged several weeks in a copper or distilled water solution, were placed in an incubator no chickens hatched. The distilled water experiments showed that it is fatal to prevent air from reaching the germinative part of the egg. The preservative effects of the copper salts might have been due to their rendering the eggs to a condition similar to that of unfertilized ones (which keep far better than the fertilized)

or inhibiting the putrefactive microorganisms without effecting germinative properties. In order to determine this, I made another series of experiments by placing eggs upright in copper and distilled water solutions with the broad end projecting above the liquid so that air could enter into that part. In another set, one half of the egg was longitudinally immersed in copper sulphate solutions and distilled water twenty-four hours, then turned so that the other half would be immersed twenty-four hours, but at all times air had free access through the upper half. After seventeen days' treatment, these eggs as well as some check untreated ones were placed in the incubator. On the twentieth day a chick hatched from an egg which had been three quarters immersed in distilled water seventeen days. I waited five days longer, and, no other chick coming out of any shell, I opened the eggs and found that two of the fertile ones had almost completely developed. One of these was from a partly submerged egg and the other from alternately immersed and daily turned one.

From the eggs containing the chicks, I sucked up part of the liquid with a pipette, digested it with sulphuric acid in a Kjeldahl flask and tested for copper. It was not even necessary to digest the liquid, as it could be diluted with water and electrolyzed direct, the copper depositing on the cathode. This evidently showed, as you see by these specimens, that embryonic growth to almost complete development took place, although the imbedded liquid was practically a copper bath. While these experiments are still very incomplete, it strikes me all signs point to the belief: that small amounts of copper salts in their selective antiseptic action towards the putrefactive ferments and unpronounced effects on others, may be of great therapeutical value.

Destruction of Invertase by Acids and Alkalies: H. S. Paine.

Samples of the same invertase preparation were kept at a constant temperature of 30 degrees for different time intervals in acid (HCl) and alkaline (NaOH) solutions at varying concentrations. At the end of the respective time periods all the samples were brought to the same acidity (the acidity favorable to optimum activity of the enzyme) in cane sugar solutions of the same strength, all volumes being equal. After an inverting action of one hour, the velocity coefficient, K, of the rate of the inversion was calculated from the formula for monomolecular reactions, viz: $K = 1/t \log (R_0 - R\infty / R - R\infty)$, where R_0 is the rotation of the pure cane sugar solution, $R\infty$ the rotation of the same solution after complete inversion and R the polarization at the time t, seconds and decimal logarithms being used in the calculation. The activity of the enzyme, as measured by the above coefficient, K, was found to decrease as the strength of the destroying acid or alkali solution was increased.

By an application of the above formula a coefficient, K', measuring the rate of destruction of the invertase was obtained as a derived value of the coefficient just referred to.

Destruction commenced at about 0.015 normal in acid and 0.01 normal in alkaline solution, requiring about five to six hours for completion at those concentrations. It was very rapid and required only about five minutes in 0.05 normal acid and 0.04 normal alkaline solution, showing that, while invertase is inactivated in very faintly alkaline solutions, the destructive action of alkalies on it is not much greater than that of acids.

In view of the fact that the degree of acidity or alkalinity of the media in which many enzymes naturally occur is subject to change, quite often between wide limits, investigations, such as the one just described, are of value in determining just when inactivation or destruction takes place. As only one instance of such media of changing acidity and alkalinity may be mentioned the alimentary tract of the higher animals, considered in its entirety.

The Estimation of Arsenic and Morphine in Animal Tissue: Charles R. Sanger.

One three-thousandth part of an ounce of arsenic and one thousandth part of an ounce of morphine can readily and quickly be detected by the new method, and it is expected that all uncertainty in post mortem examinations will be eliminated by the new method of analysis.

Stagnation vs. Circulation in House Air: Ellen H. Richards.

The science of living is more and more engaging the attention of those who are exploring the borderland of chemical physics of chemical biology. No part of this land is more unknown than the air we breathe and its significance in mental activity.

In no quarter do we do greater wrong than to our young students, by compelling them to listen to lectures, and to work, in an atmosphere that dulls their wits and befogs their minds. It is quite time that the biophysicist wrote a convinc-

ing tract on draft and its necessity. Let us take advantage of the tuberculosis scare and change the habits of people so that they may not need to drop all their occupations and sit in a draft all day doing nothing.

An artificial life demands artificial means of securing the advantages of natural living. One man's fresh air is another man's draft and the most difficult part of the ventilation problem is to reconcile the interests of both these classes of persons.

It is now pretty generally recognized among the scientific workers most familiar with the facts, that there is little danger from breathing germs except from direct contact with the particles given off by sneezing, coughing, etc., and this only within a radius of ten feet or so of the distributing factor. Also that in itself carbon dioxide, up to even 50 or 75 parts in 10,000 does not disturb the individual in a cool, dry room.

The window lowered an inch at the top is of more power than raised a foot at the bottom. Because air is invisible, the average person ignores it. If more attention could be paid to air currents, to the mixing of air, and as an aid to this, if the air of halls could be kept cooler, vast benefit would result. Heat and humidity are the most dangerous products of still life, because they so soon endanger the activity of the cells and raise the body temperature.

Odors also form no unimportant part in the causes for discomfort in our enclosed spaces. May not circulation of air combined with ozonization do much to eliminate this? We have tests under way looking to this end.

The following papers are reported by title:

Industrial Bacteriology as a Field for Biochemical Investigation: SAMUEL C. PRESCOTT. (Chairman's address.)

Studies upon the Physiological and Chemical Toxicology of the Sap of the Manzanillo Tree: JOSE A. FERNANDEZ BENITEZ.

Some Points in the Analysis of Proteins: T. B. OSBORNE.

A Method for the Determination of Amino Nitrogen and its Applications: DONALD D. VAN SLYKE.

The Anaphylactic Reaction as a Specific Test for Protein: M. J. ROSENAU.

The Manganese-bearing Tissues of the Fresh-water Mussels: H. C. BRADLEY.

The Relation of Typhoid Fever to the Water Supplies of Illinois: EDWARD BARTOW.

The Action of Enzymes on Sugars: C. S. HUDSON.

The Cause of Depression Produced by Molasses: J. B. LINDSEY.

The Chemical Organization of a Typical Fruit: A. E. VINSON.

Fixing and Staining Tannin in Plant Tissues: A. E. VINSON.

DIVISION OF ORGANIC CHEMISTRY

R. S. Curtiss, *Chairman*
Ralph H. McKee, *Secretary*

Advances in the Chemistry of Coal-tar Colors: HUGO SCHWEITZER.

Enormous progress is yearly made in the industry of coal-tar colors where the far-reaching possibilities of chemistry have been recognized. It is the popular idea that aniline colors can not stand the influence of light. This is due to the fact that the first aniline colors were poor. This is not true of the aniline colors now made. The most wonderful advances in the production of new colors of extreme fastness are to be found in the class of alizarin colors, which for the last twenty years have played a very important part in the dyeing industry.

Many interesting experiments have been made to determine the fastness of certain dyes, among them the experiment of dyeing a blue fabric and exposing it to the sun's rays at the height of many thousand feet. Since a method has been discovered for the manufacture of artificial indigo economically, many different kinds of dyes have been made from this indigo, which plays an important part in the industry. Friedländer has made some interesting investigations to show that the purple of the ancients, which was derived from purple shell fish of the Mediterranean, was identical with some of the modern derivatives of indigo. From 12,000 shell fish he obtained one twentieth of an ounce of color, which shows why it was so precious and expensive in the olden times.

Within a few years it has even been possible to make coal-tar colors for the use of artists. While the product in Thessaly of a few pounds of dyestuff would be sufficient to supply the painters of the world with this color it is practically nothing. Experiments were carried out for the benefit of art. They are being continued so that in the end organic colors will reign supreme in this field.

A comparison of the natural colors of a few years back with the artificial colors of to-day show that in every case the artificial colors are

much better as well as cheaper, while the variety of shades that can now be obtained is almost infinite. The much-vaunted achievements of the good old times are of necessity a myth as far as fastness of dyes or superiority of textiles are concerned, and the purple and fine linen of the ancients would look decidedly queer in a modern department store. The fabrics which the daughters of the Pharaohs used for their personal adornment would not find favor in the eyes of the poorest women of the present day.

Saponification of Formic Esters: J. Stieglitz and Edith Barnard.

The velocity coefficient for the saponification of ethyl formate by the hydroxyl ion at 25° was determined by means of a mixture of ammonium hydroxide and chloride and found to be 1,840. For methyl formate the constant 2,800 was found. At the same time there is amide formation, the constant for which was found to be 0.13 for methyl formate at 25°.

Stereoisomeric Chlorimidoketones: J. Stieglitz and P. P. Peterson.

Stereoisomeric chlorimido-p-chlorbenzophenone, chlorimido-p-methoxybenzophenone and chlorimido-p-chlor-p-methoxybenzophenone were described.

Phthalamidic Acids Substituted in the Benzene Nucleus: J. Bishop Tingle and S. J. Bates.

It has been shown by the senior author and his co-workers that phthalamidic acids, $RNHCOC_6H_4CO_2H$, when warmed with amines are transformed readily into imides,

$$C_6H_4<\begin{matrix}CO\\CO\end{matrix}>NR,$$

and other products. Aliphatic amidic acids of a similar type,

$$RNHCOC\overset{||}{\underset{||}{C}}CO_2H,$$

under similar conditions, fail to react in this manner and their salts with amines are also stable. The investigation has been extended to include several amidic acids derived from 3-nitro-, 4-nitro-, 3, 6-dichloro- and tetrachlorophthalic acids, in which R as in the formula above is phenyl- or β-naphthyl-. The general effect of these substituting groups (Cl or NO_2) is to render the amidic acid very stable towards amines, but it is readily changed to the imide by the action of alcohol which may be as dilute as 50 per cent. The reaction is not produced by other solvents under similar conditions of temperature.

Camphor phenyl- and β-naphthylamidic acids are not dehydrated by amines. Camphoric acid therefore behaves like an aliphatic compound.

Melting and Boiling Points of Certain Disubstitution Products of Benzene. By J. Bishop Tingle.

The statement, which is rather widely current, that para disubstituted benzene derivatives usually melt and boil at a higher temperature than the isomeric ortho- and meta-compounds requires qualification, as is shown by the following results:

Boiling Points.—(1) The b. p. *increases in the order ortho-, meta- and para-* in the case of compounds containing the substituents Cl, OH; Br, OH; I, OH (?); OH $(OH)_2$; CH_3, NO_2; CH_2, NO_2; C_2H_5, NO_2; CH_3, Br; CH_3, CO_2H. (2) The b. ps. of the *meta- and para-compounds are essentially identical and are lower than those of the ortho-derivatives* when the substituents are CH_3, Cl; $(CH_3)_2$; $(C_2H_5)_2$; Cl_2; Br_2; I_2 (?); Cl, Br; Br, I; Cl, I (?); $(NO_2)_2$ (?); HO, NO_2 (?); Cl, NH_2; Br, NO_2. (3) The b. p. *rises in the order meta-, ortho-, para-* in the case of the compounds, $CH_3CH_2CH_2$, CH_3; C_2H_5, NH_2; $(NO_2)_2$ (?); HO, NO_2 (?). (4) *The increase of temperature is in the order meta-, para-, ortho-* with the substituents Cl, NO_2; I_2 (?); HO, NO_2 (?). (5) *The increase is in the order para-, meta-, ortho-* in the case of Cl, I. This is the converse of 1. (6) The order is ortho-, para-, meta- with the groups $(NH_2)_2$. (7) The b. p. of the *ortho- and meta-compounds are essentially equal, that of the para-derivative being higher* in presence of CH_3, I. (8) The b. p. of the *ortho- and para-*derivatives are substantially equal, those of the *meta-*compounds being higher or lower in the case of C_2H_5, Br; $(CH_3)_2CH$, CH_3.

Melting Points.—The m. ps. of the substances mentioned above are much more simple. The following come under class (1) above: HO, Cl (?); HO, Br (?); $(OH)_2$; HO, NO_2; H_2N, NO_2; Cl, NO_2; Br, NO_2; $(CO_2H)_2$ (?); H_2N, CO_2H; CH_3, CO_2H; H_2 (in the case of $C_6H_2I_4$); I_2; CH_3, NO_2. The remaining compounds fall into class (3) above. They are as follows: I, NO_2; Br, NH_2; I, OHX; I, NH_2; HO, NH_2; $(NO_2)_2$; O_2N, CO_2H; C_2H_5, CO_2H; $(NH_2)_2$.

No m. ps. have been found which correspond to the relationship shown in the b. ps. of the compounds in classes (2), (4), (5), (6), (7) and (8). The small number of substances in the last four classes suggests that the published data may require correction. The classification given above is based on the best figures which were available,

but from the nature of the case, the degree of accuracy attained by different investigators is very variable. In the case of compounds followed by (?) the classification is open to doubt.

Hydrazones of Certain Oxy-Ketones; Alkali-Insoluble Phenols: HENRY A. TORREY.

Although it is a very general rule that phenols are soluble in aqueous alkalies there are certain substances of this class that are marked exceptions. The phenolhydrazones of certain acetophenols and acetonaphthols are entirely insoluble in aqueous alkalies. This alkali-insolubility is determined by two conditions: (1) the free hydroxyl group is ortho to the substituted ketone side chain; (2) other substituting groups, as OCH_3, or hydrocarbon groups are present.

The importance of the second condition is seen in the fact that while the phenylhydrazone of o-oxyacetophenone is soluble in aqueous alkalies, the same derivatives of paeonal or a-acetonaphthol are insoluble. The azines of a-acetonaphthol is insoluble in aqueous alkalies, whereas in general the azines have been found soluble, even though the phenylhydrazones are insoluble. No condensation between the imino and hydroxyl groups has taken place. There seems to be no evidence to suggest that these alkali-insoluble phenols should be weaker acids than corresponding bodies that are soluble. The acetyl derivatives obtained by Auselmino from similar alkali-insoluble phenylhydrazones of oxyphenylaldehydes point to the presence of the hydroxyl group. It is possible that the consideration of a quinoid structure may assist in the explanation of the alkali-insolubility of these compounds. They furnish an interesting instance of the effect that a substituting group may have upon the whole equilibrium of the molecule.

Furoylacetic Ester and Furyl-Pyrazolones: HENRY A. TORREY and J. E. ZANETTI.

Furoylacetic ester, as might be expected, closely resembles acetacetic ester and benzoylacetic ester. Its oxime, however, is more stable, although it can be converted into the corresponding isoxazolone without difficulty. The comparative stability of the oxime shows that the furyl group has a greater attraction for the hydroxyl of the oxime radicle than would be indicated by the position assigned to it by Hantzsch in his list of groups arranged in order of their power of attraction for hydroxyl in this class of compounds. Since pyromucic acid has a considerably higher dissociation constant than either benzoic acid or acetic acid, the comparative stability of the oxime of furoylacetic ester is better explained by the views of Abegg, according to which the difference in electrical charges of the groups influencing the hydroxyl of the isonitroso group is considered.

Furoylacetic ester forms hydrazolones easily with hydrazines, thus with aryl hydrazines, 1-aryl 3-furyl 5-pyrazolones are given. As would be expected, these pyrazolones show tautomeric relationships. With benzaldehyde a condensation product was formed with one molecule of the pyrazolone and with diazo salts highly colored azo compounds were prepared. Acetyl and benzoyl derivatives were readily formed.

From 1-phenyl 3-furyl-5-pyrazolone by the action of methyl iodide the hydriodide of 1-phenyl 2-methyl 3-furyl-5-pyrazolone was obtained, an analogue of the drug "antipyrine." Other salts, such as the hydrochloride and hydrobromide, were made, but owing to the negative nature of the furyl group they are easily hydrolyzed by water giving the free body in the form of an oil difficultly soluble in water.

Methyl Phenyliminomalonate and its Reactions: RICHARD SYDNEY CURTISS and F. GRACE C. SPENCER.

This compound $C_6H_5N=C(CO_2CH_3)_2$ is made by the action of P_2O_5 on methyl anilinotartronate, the addition product of aniline on methyl oxomalonate. It shows remarkable reactivity at the nitrogen-carbon double bond. Moisture of the air rapidly changes it to methyl dianilinomalonate and methyl dihydroxymalonate; a complex reaction, involving the formation of aniline and methyl dehydroxy malonate and their interaction to produce the final products. Aniline acts on methyl phenyliminomalonate giving methyl dianilinomalonate. Alcohols, amines and many other classes of compounds containing easily dissociable hydrogen, add directly to the double bonds. The substance is a striking analogue of phenylisocyanate. Mercuric oxide oxidizes methyl anilinomalonate yielding methyl dianilinomalonate and methyl oxomalonate. This reaction is complex and its mechanism may be explained by assuming that methyl anilinotartronate first formed dissociated to methyl phenyl iminomalonate, and that this was changed by water into the final products as stated above. Further studies are in progress on phenyliminomalonates.

On 4- and 5-acetamino Acetanthranils and Quinazolines derived therefrom: M. T. BOGERT and C. G. AMEND.

2, 4- and 2, 5-tolylene diamines were acetylated, the acetyl derivatives oxidized to the corresponding diacetamino benzoic acids, and the latter converted into the acetamino acetanthranils by boiling acetic anhydride. By condensing these acetamino acetanthranils with primary amines, and other primary amino compounds, acetaminoquinazolines were obtained, from which the acetyl group was easily removed, leaving amino quinazolines whose amino groups were then subjected to various well-known aniline reactions.

The Preparation of Styrolene Alcohol: Wm. Lloyd Evans and Lou Helen Morgan.

Styrolene diacetate can be prepared quantitatively by the interaction of fused lead acetate (1.5 mols.) and styrolene diacetate (1 mol.) dissolved in glacial acetic acid (six times the weight of the dibromide used). The reaction begins at 120° and is practically complete at 125°. Styrolene alcohol can be prepared by the hydrolysis of styrolene diacetate (1 mol.) by means of potassium carbonate (1.5 mols.) dissolved in water (twenty-five times the weight of the diacetate used), the solution being kept to boiling for two hours. From the cooled reaction mixture, subsequently saturated with potassium carbonate, the greater portion of the alcohol may be precipitated, the remainder being obtained from the filtrate by extracting with ether. Oxidation experiments are now in progress on styrolene alcohol and also on propylene glycol.

The Glycogen Content of Beef Flesh: P. F. Trowbridge and C. K. Francis.

The experiment in enzymatic hydrolysis has been continued on similar lines to those reported in the previous paper, working on the liver of beef animals instead of the shoulder muscle. At temperature of 20° to 25° a liver, containing 3.15 per cent. glycogen when exposed for about three days contains about 2 per cent. of glycogen.

Various authorities state that horse flesh contains from 1 to 2.4 per cent. glycogen and it is claimed the muscle of the ordinary horse has as much glycogen as the liver. Our investigations have not confirmed this assertion. Working on a sample of fresh horse flesh obtained from a thin animal about twenty years old, we have obtained only 0.18 per cent. glycogen in the muscle. In twenty-one hours this amount was decreased 67.3 per cent., while in three days the loss was 91.1 per cent., accompanied with a slight decomposition of the sample. In the fresh shoulder muscle of beef we have found as high as 0.7 per cent. of glycogen as previously reported. According to these results the determinations of the glycogen as distinguishing horse flesh from beef is of no value.

The following papers are reported by title:

Synthetic Medicinals: Recent Progress in Relationship between Physiological Action and Structure: Virgil Coblentz.

The Action of Acetylene on Iodine Trichloride: H. Edmund Wiedemann.

The Condensation of Methyl-ethyl-ketone by Acids and Alkalies: Alfred Hoffman.

The Constitution of Retene and its Derivatives: John E. Bucher.

The Properties of the Hexa-substitution Products of Ethane: James F. Norris.

Studies in Tautomerism: S. F. Acree.

The Basic Properties of Oxygen; Compounds of Dimethylpyrone and the Halogen Hydrides: D. McIntosh.

The Constitution of Ortho-benzo-quinone: Wm. McPherson and Howard J. Lucas.

Esterification and Steric Hindrance: M. A. Rosanoff, C. D. Wright and T. F. Power.

The Constitution of the Carboxonium Salts: M. Gomberg and L. H. Cone.

The Constitution of the Carbothionium Salts and of the Acridine Salts: M. Gomberg and L. H. Cone.

The Constitution of Benzene from the Standpoint of the Corpuscular-atomic Conception of Positive and Negative Valences: Harry Shipley Fry.

The Formation of Cyclopentadiens: William J. Hale.

Some Organic Compounds of Selenium: Howard W. Doughty.

A Measure of Thermodynamic Positivity and Negativity in Water Solution with Reference to Chemical Reactions of Organic Compounds: C. G. Derick.

The Addition Power of Methylethyl-ethylene: Roger F. Brunel.

Equilibrium at High Temperatures between Isolutyl Bromide and Tertiary Butyl Bromide: Roger F. Brunel.

The Iodine Compound of Pinene and the Resin formed by the Action of Iodine on Pinene: G. B. Frankforter and B. F. P. Brenton.

Chemical Education Section

Lyman C. Newell, *Chairman*

The Purpose and Method of the Chemistry Course in the Public High School: Frank B. Wade.

The author first classified his material into three groups: (*a*) those who expect to go to college, (*b*) those who wish to use their chemistry vocationally, (*c*) those who wish chemistry as part of a good general education. He regarded (*a*) as a majority of influence, but (*c*) as a numerical majority. He next showed that the best course for class (*a*) would really serve classes (*b*) and (*c*) better than any other course.

Going more into detail, it was shown that for all three classes the course should be along broad general lines. The fundamental principles, the leading facts and the most useful theory should be taught. More than all else the scientific mode of thinking should be inculcated, together with the habit of going to things themselves rather than to authorities for facts. The ability to attack hard problems systematically and successfully should be imparted to the pupils.

This sort of course was shown to be the best possible preparation for college chemistry, also for vocational chemistry and for general training.

In the last part of his paper the author took up briefly the matter of how the kind of course outlined might be taught, and attempted to convey an idea of the spirit of the method rather than pedagogic details of method, placing emphasis upon open mindedness and breadth rather than upon specialization in high school chemistry.

Content and Method of the First Course in Chemistry: M. D. SOHON.

The social development has been so largely shaped through the application of scientific principles that an understanding of the elementary principles of physics and chemistry is necessary for the ordinary man.

The introductory course should be so adapted as to be within the capacity of any child in the high school. It should be planned for the many rather than the few.

The content of the course should be such as to give a comprehensive view of the principles involved in *ordinary* chemical phenomena, together with non-technical treatment of commercial products, their sources, utilization and preparation.

The difficulties of the subject are largely artificial and due to acceptance of traditional methods and content. The theoretical conceptions are difficult, but fortunately such are not essential to the study of the principles involved in the elementary study of the subject.

This can be done better with elementary pupils by the systematic study of topics and of processes than by the study of elements. Traditional methods followed by texts fail to make use of modern experiences and facilities in their method and arrangement. The subject should be approached from the side of the pupil, sacrificing, if necessary, the formal development as a science.

Laying aside the old methods and examining the subject from the side of the pupil, there is ample material to be drawn upon, facts worth knowing. Their relations and values may be taught with little or no regard to abstractions.

For the pupil who will continue in school it will serve as a foundation for more intensive work. The pupil who does not continue will have had his interests aroused to increased efficiency.

Pressure should be brought to bear upon the schools to make the instruction more practical. It is within the power and is the duty of the society to meet this and say what is desirable or practical and not leave this to popular clamor or self-constituted authorities.

The Relations of the Common and of the more Uncommon or Immiscible Reagents: CHARLES S. PALMER.

A short paper urging the teaching of the action of the common acids, bases and salts on the common oils, fats, waxes, and such substances as paper, sizing, ink, cotton, wool, etc. All this should be shown the beginner, and adopted and incorporated with the usual good theory and practise. This means more thorough courses in preparatory chemistry comparable with the completeness and thoroughness of the good old-fashioned specializing in Latin and Greek. This toning up of preparatory chemistry should come from the inspiration and insistence of the college influence on the preparatory school.

Elementary Chemistry in the Vocational High School: LYMAN GORHAM SMITH.

The vocational school trains for efficiency in special lines of work, and generally makes but indirect use of chemistry. Employers are demanding that the pupil acquire habitual knowledge, or that he be well drilled; educators, on the other hand, unanimously emphasize the value of the development of initiative, and of the power of independent judgment. The latter must be protected, as it is against the best interests of pupils to make them merely the profitable tools of employers. Schools can do much to train more efficient and useful workers, but the spirit of ideal democratic American education is not to be neglected.

The scientific attitude of observing accurately and drawing sensible conclusions is a most essential element in vocational education. Plato, Leonardo da Vinci, Charles Kingsley and many others, including a host of theoretical and practical modern educators, are earnest advocates of the scientific method. The spirit of investigation is natural to even young children. Leaders in pedagogy and in science in England, in Germany and in America are promoting inductive laboratory study. Vocational high schools need to train pupils for power of judgment, must teach fundamental principles, and such cases of the practical applications of chemistry as are typical. The difference between factory and laboratory practise should be made clear. Works should be visited, and a few experiments, at least, should be carried out on a commercial scale by the pupil. Much real inductive laboratory study is essential at the start, and an acquaintance with the spirit of the methods of attacking practical experimental problems should be gained. Above all, at the beginning of the study of chemistry, the pupil should be made independent of text-books, the authority of which he should learn to regard with discriminating suspicion; though later he may use them to some advantage. Many of the subjects taught in high schools, as algebra, depend on text-books, but the peculiar quality of science instruction lies in the cultivation of the scientific attitude. The conscientious pursuit of truth is an important moral element in education. Efficiency in vocational education results from accurate and reliable knowledge, respect for scientific methods, regard for the evidence furnished by data, and appreciation of the value of the work of experts.

The Case Against Qualitative Laboratory Experiments: Edward Ellery.

The case against qualitative laboratory practise is as follows:

1. It is a waste of the student's time to repeat in the laboratory what has been done in the lecture room. There is so much to give now like the thermal and electrical relations that time can not be spared for the student to find out whether an element acts or does not act as the book says.

2. The student gets a wrong idea of the rigidity of the laws and the care and accuracy necessary in chemical work by his careless performance of the experiments.

3. Such qualitative experiments do not make for independence. The notes can be written up from what is given in the books or seen in the lecture room. Such work is not the most profitable use to make of one's time.

4. Good results are often not obtained, due to use of faulty apparatus, hurried work and careless use of materials.

The advantages of doing quantitative work are pointed out. They may be summed up as follows: (1) quantitative experiments are not beyond the capacity of beginners, (2) quantitative work emphasizes the chemistry of the reactions and demands more critical observation, (3) the cost of fitting up a quantitative laboratory need not be large, (4) the experience gained in quantitative experiments will be of use later on when the student does analytical work.

The Teaching of Chemistry in Secondary Schools: Mosby G. Perrow.

It is pointed out in this paper that too much is attempted in a one-year course in a secondary school. This is due to the severe entrance requirements of some colleges and to the very many subjects given in the text-books. As a result no thorough careful work is done and the student gets discouraged at the amount of work he has to do.

Educational Value of Chemistry: W. S. Leavenworth.

The difference is brought out between a study of the classics and a study of physical science. The advantages of laboratory work are given in which it is shown that it cultivates clear thinking and right doing, develops perception and the rational faculties and inculcates the capacity for honest, thorough work. In the laboratory the student learns by doing and does by learning. The laboratory demands accuracy of eye, teaches necessity for care, exactness and cleanliness. The imagination also has a place in chemistry, as we see from Dalton and Mendeleff. Chemistry is an enemy to superficiality; it cultivates clear expressions and exact thought, in a broad way it teaches us why and how to live. Science in its best and broadest sense gives us the only rational explanation of living and therefore is essential to any system of education.

A Method of Preparing Qualitative "Unknowns": L. J. Curtman.

The stock solutions are prepared of strength indicated in column 5 (except in cases where the solubility of the salt will not permit of such a concentration) and kept in bottles of one or two liters capacity provided with graduated pipettes. We are thus able to deliver definite quantities of

Substance	Formula Weight	Solubility in 100 pts. of Water at 20°	Per Cent. Metal	Quantity of Salt to be Dissolved in 1 Liter to Give Strength 1 c.c. = 100 mgs. of Metal
NaCl	58	35 g.	40	250
KNO_3	101	25	39	257
NH_4NO_3	80.1	200	22.5	445
$BaCl_2 2H_2O$	244	41	56	180
$Ca(NO_3)_2 4H_2O$	236.2	extremely soluble	17	590

these standard solutions to students as "unknown" bottles; these consist of homœopathic vials of 50 c.c. capacity. For the analysis the student takes 25 c.c. of his solution, the other half being reserved in case of accident.

The amounts of standard solutions pipetted out should be such as to yield a suitable concentration when the volume is diluted to 50 c.c., *i. e.*, when the bottle is filled.

Example: Pipetted out into "unknown" bottle: 1 c.c. NaCl sol, 2 c.c. $Ca(NO_3)_2$, 1 c.c. NH_4NO_3, and then fill the bottle with distilled water.

Since the student uses only 25 c.c. of this solution the latter will contain: 50 mgs. Na, 100 mgs. Ca, 50 mgs. NH_4.

The following papers were reported by title:

Conditions under which Secondary School Teachers Conduct their Work: ALBERT L. SMITH.

Conditions and Equipment in Secondary Schools: CHARLES R. ALLEN.

Elementary Chemistry Teaching as a Means of Developing the Power of Independent Scientific Reasoning: ARTHUR A. BLANCHARD.

The First Course in Chemistry for Secondary Schools: M. D. SOHON.

D. L. RANDALL,
Press Secretary

SOCIETIES AND ACADEMIES

THE GEOLOGICAL SOCIETY OF WASHINGTON

AT the 225th meeting of the society, held on Wednesday, January 12, Mr. Fred. E. Wright exhibited specimens of obsidian from Hrafntinnuhryggur, Iceland, with peculiarly pitted surfaces, resembling the markings of the Austrian moldavites; also a unique type of crystallization of radial spherulites in cavities of that obsidian.

Mr. David White exhibited a photograph of an unusually large and complete Stigmaria stump, taken in an anthracite mine near Scranton, Pa. It afforded an excellent illustration of a "kettle bottom" or "pot," a common source of danger in coal mines, and clearly showed the hole in the roof above the fallen stump.

Mr. Chas. Butts described a Carboniferous coal bed overlain by Lower Cambrian limestone, near Aldrich, Ala., the limestone being thrust over the coal at the fault bounding on the east the Carboniferous rocks of the Cahaba trough. The coal is completely overturned, lies flat at the exposure, and is unchanged except for being crushed and mixed with shale.

Regular Program

Influence of the Earth's Rotation on the Lateral Erosion of Streams: H. M. EAKIN.

Observations on Alaska rivers indicate a higher efficiency of the deflective force of the earth's rotation in determining lateral erosion of streams than has been ascribed to it. The Yukon River and its tributaries, the Tanana, Koyokuk and Innoko, and the Kuskokwim, all large Alaska streams, show a marked predominance of erosion on the right bank. The strength of the deflective force as computed and compared at different latitudes shows it to be much stronger in the higher latitudes. For instance, for latitudes 5°, 25°, 45° and 65°, the ratios are approximately 1 to 4.8 to 8.0 to 10.3. The effectiveness of the deflective force may be compared with that of the centrifugal force of various curves of rivers, that of the deflective force at latitude 65° being approximately equivalent to that of the centrifugal force developed on a curve having a radius of 6.2 miles, computations being based on an assumed velocity of 2 meters per second. The lateral stresses due to either centrifugal force or deflective force tend to establish cross gradients which would oppose them. The lateral stresses being weaker in the lower part of the stream, the stronger lateral gradient supported by the upper part of the stream sets up an undertow in a direction opposite to that of the lateral stresses. The results of the boring currents thus produced are expressed in selective cut and fill. The deflective force being to the right in the northern hemisphere combines with the centrifugal force on right curves and opposes it on left curves. On straight reaches the deflective force acts alone. In a meandering stream the lateral gradients are reversed on successive bends and the lateral stresses are not fully expressed in lateral currents, since they are under conditions of acceleration much of the time. On straight reaches, there

being no reversal of lateral gradient, the deflective force becomes relatively much more efficient in inducing lateral currents.

The Missouri River, studied for comparison with the rivers in higher latitudes, shows evidence of unbalanced lateral erosion in the distribution of its flood plain with respect to its course.

Winds, crustal warping and asymmetry of drainage basins are other causes which may unbalance lateral erosion, but conditions do not point to their operation in the cases mentioned. The unbalanced erosion in the Alaska rivers, therefore, seems undoubtedly due to the deflective force of the earth's rotation.

Geologic Thermometry: Fred. E. Wright.

In ordinary thermometry, temperature, or the degree of hotness of a body, is defined by the expansion of a perfect gas and is expressed in terms of fixed units, determined by the freezing and boiling points of water under standard conditions. Temperatures are ascertained practically by means of thermometers which, although they vary greatly in type, are all based on some property which varies in a definite way with the temperature. In geology, temperatures are of fundamental importance, particularly the temperatures to which rocks were heated in past geologic ages and under inaccessible conditions. Points on the geologic thermometer scale must therefore be historic points, or temperatures at which permanent changes occur in the rock or mineral, traces of which persist at lower temperatures. Such definite points serve to establish limits within which observed reactions must have been effected. The factors which may serve to furnish points of this nature are, especially: melting temperatures of stable minerals and of eutectics; inversion temperatures of minerals; temperature limits beyond which monotropic forms can not exist under different conditions of pressure; stable ranges of enantiotropic forms and of minerals which dissociate or decompose at higher temperatures; temperatures beyond which any physical property acquires a permanent set and by virtue of internal friction or other cause does not return to its original value on cooling; also the occurrence of zonal growth in isomorphous mixtures like the feldspars or pyroxenes. These factors can be and are being determined by modern laboratory methods and are in turn directly applicable to the study of rocks. In applying such data geologically, however, it should be remembered that the data are obtained under certain definite conditions while in nature the rocks may have been and often were formed under totally different conditions of equilibrium. Two factors particularly may be operative in this direction, pressure and solution, or the presence of other components, as water, which tend to modify very materially the equilibrium criteria and behavior of the physical chemical system in question. The data now available on the geologic thermometer scale indicate that the establishment of such a scale is feasible and can be accomplished by a sufficient number of proper laboratory determinations; also that in many cases the application of such data to natural phenomena is warranted.

The Origin of the Pegmatites of Maine: Edson S. Bastin.

The pegmatites of Maine all belong to the type commonly known as granite pegmatites. The fact that their chief minerals are also the dominant minerals of the granites, the presence of granite in all districts where pegmatites occur, and numerous observed transitions from granite to pegmatite, indicate that the pegmatites are closely related to the granites in origin.

The peculiar textures exhibited by the pegmatites as compared with the granites are *not* believed to be due mainly to differences in the proportions of the principal mineral constituents or of the rare elements such as fluorine, lithium and phosphorus, but probably to greater abundance of gaseous constituents in the pegmatite magma as compared with the granite magma. The principal gaseous constituent was probably water. There are field indications that the pegmatite magmas locally exhibited a considerable degree of viscosity, sufficient for example to float fragments of the schist wall rock. This and other facts suggest that the vaporous content of the pegmatites was not so greatly in excess of that of the granites as has commonly been supposed. Experiments by F. E. Wright and E. S. Larsen on specimens collected by the writer from the pegmatites of Maine show that the quartz from the finer-grained pegmatites and from the graphic granite of the coarser pegmatites crystallized above 575° C., whereas that of the large areas of pure quartz, the quartz crystals, developed in miarolitic cavities and the quartz associated with tourmaline, lepidolite, spodumene, etc., near the pockets in the gem-bearing pegmatites, was formed below 575° C. This fixes the temperature of crystallization of many of these pegmatites at about 550° and 600° C.

François E. Matthes,
Secretary